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THE AMERICAN MOSQUITO CONTROL ASSOCIATION, INC.

ARTICLES

PRESENT STATUS OF MOSQUITO RESISTANCE TO INSECTICIDES IN THE SAN JOAQUIN VALLEY IN CALIFORNIA

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AND
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The resistance of mosquito larvae to DDT in California was first reported by Smith (1949) in Kern County. The following year Bohart & Murray (1950) showed that larvae of *Aedes nigromaculis* (Lud.) were resistant to this insecticide in Tulare County. More comprehensive studies by Gjullin & Peters (1952) showed that resistance to chlorinated hydrocarbon insecticides was present in larvae of *A. nigromaculis, Culex tarsalis* Coq., and *C. quinquefasciatus* Say throughout the treated areas of the San Joaquin Valley from Merced County in the north through Kern County in the south. Moderate resistance was present in the northern portion and high resistance in the southern portion of this 200-mile-long area. The complete failure of these insecticides in the southern portion in 1951 made it necessary for the control districts to use organic-phosphorus compounds. EPN, parathion, or malathion have been used by these districts since that time. Higher resistance has also developed in the northern end of the area, and all districts in this section have changed to the organic-phosphorus compounds in the last two or three years.

A partial resurvey of the San Joaquin Valley by the authors (Isaak 1956, Gjullin 1956) showed that resistance to DDT had increased in the areas that were sampled. Larvae taken outside the boundaries of the districts, where no resistance had been present in 1951, are now as resistant as larvae taken inside the districts. This paper reports further tests on the resistance of mosquitoes to organic-phosphorus insecticides and DDT in Fresno and Kern Counties in 1956.

TESTS WITH LARVAE.—Early fourth-instar larvae were collected from breeding places inside and outside the abatement-district boundaries. The test procedures were similar to those described by Gjullin & Peters (1952). Sufficient insecticide in acetone was added to 200 ml. of tap water to give the desired concentration. The tap water used in different areas had shown no significant variation in percentage of kill. Two containers with 20 larvae in each were used per test.

Data obtained with *tarsalis* (Table 1) show that this species had developed resistance to malathion in a number of locations in the Fresno abatement district during the 2½ years that this insecticide has been used. The amounts of malathion required for 50 and 90 percent kills are now 21 and 33 times greater, respectively, than are required for larvae taken from untreated areas outside the district. No parathion has been used in the Fresno district. Malathion or various other agricultural insecticides have not produced cross-resistance to parathion in this species.

Untreated *nigromaculis* larvae could not be found in sufficient numbers for adequate comparison with malathion-treated larvae of this species from the Fresno district. However, no resistance to malathion or cross-resistance to parathion was indicated in the results that were obtained (Table 2).

In the Fresno district DDT resistance

TABLE 1.—Percent mortality of *Culex tarsalis* mosquito larvae from treated and untreated areas when exposed to various concentrations of malathion, parathion, or DDT

Insecticides (p.p.m.)	Fresno County		Kern County	
	Treated Areas	Untreated Areas	Treated Areas	Untreated Areas
Malathion	5 areas	4 areas	6 areas	5 areas
3	94	..	..	..
2.5	92	..	..	..
1.4	69	..	..	..
1.0	57	..	..	..
0.2	30	..	..	..
.1	33	..	..	..
.08	..	94	76	..
.06	23	84	72	93
.03	8	29	42	68
.01	..	3	10	20
LD-50	0.73 p.p.m.	0.035 p.p.m.	0.035 p.p.m.	0.2 p.p.m.
LD-90	2.44	.73	.135	.058
Parathion	3 areas[a]	4 areas	6 areas	4 areas
0.01	93	89	..	..
.008	..	..	98	..
.005	54	63	52	91
.004	20	..	..	..
.003	4	28	34	73
.002	..	..	28	48
LD-50	0.0043 p.p.m.	0.0052 p.p.m.	0.0035 p.p.m.	0.0032 p.p.m.
LD-90	.0083	.0092	.006	.0048
DDT	5 areas	..	..	..
1.2	91	..	..	..
1.0	87	..	..	..
0.5	81	..	..	..
.2	50	..	..	..
.1	26	..	..	..
LD-50	0.2 p.p.m.	..	..	..
LD-90	1.0	..	..	..

[a] Treated with malathion. Parathion was tested against these larvae to determine if cross-resistance had developed.

in both *tarsalis* and *nigromaculis* was indicated to be two or three times greater than in 1951. This compares with results obtained in Merced, Tulare, and Kern Counties. Meltzer (1956) obtained high resistance to Diazinon, DDT, dieldrin, and toxaphene in house flies through selection pressure with Diazinon. March *et al.* (1956) also found that selection with parathion and Diazinon induced high levels of resistance in house flies to DDT, methoxychlor, and dieldrin. This suggests that increased resistance to DDT in mosquito-abatement districts may have been brought on by the use of organic-phosphorus compounds as well as the chlorinated hydrocarbon insecticides for agricultural purposes.

In the Kern Mosquito Abatement District, which had been routinely sprayed with EPN and parathion since 1951, neither *tarsalis* nor *nigromaculis* showed any resistance to parathion or cross-resistance to malathion.

TESTS WITH ADULTS.—*C. tarsalis* females from the Fresno Mosquito Abatement District and from untreated portions of Kern County were exposed to malathion residues to determine resistance. All females were obtained from larvae and pupae collected in these areas. Those from the Fresno district were taken in pastures

TABLE 2.—Percent mortality of *Aedes nigromaculis* mosquito larvae from treated and untreated areas when exposed to various concentrations of malathion, parathion, or DDT

Insecticides (p.p.m.)	Fresno County		Kern County	
	Treated Areas	Untreated Areas	Treated Areas	Untreated Areas
Malathion	3 areas	1 area	5 areas	2 areas
0.08	..	..	..	91
.06	82	83	81	75
.04	72	30	..	..
.02	34	0	81	64
.01	20	10	27	4
.005	8	..	..	..
LD-50	0.022 p.p.m.	..	0.016 p.p.m.	0.015 p.p.m.
LD-90	.07	..	.068	.065
Parathion	3 areas[a]	1 area	5 areas	3 areas
0.01	94	63	..	..
.005	69	35	92	98
.003	33	10	73	72
.001	2	8	20	25
LD-50	0.0038 p.p.m.	..	0.019 p.p.m.	0.017 p.p.m.
LD-90	.0084	..	.047	.036
DDT	3 areas	..	2 areas	2 areas
0.8	79	..	..	..
.6	74	..	..	..
.4	69	..	90	89
.2	63	..	69	71
.1	41	..	48	29
.08	..	..	31	26
LD-50	0.22 p.p.m.	..	0.125 p.p.m.	0.145 p.p.m.
LD-90	.85	..	.38	.42

[a] See footnote to Table 1.

where previous tests had indicated high resistance to malathion. Untreated females for comparison were obtained from Kern County, because this species was not available in sufficient numbers from untreated portions of Fresno County.

Acetone solutions of malathion were placed in petri dishes and allowed to dry for 24 hours. Deposits of the insecticide ranging from 0.25 to 14 mg./sq. ft. were made on the dishes by using different amounts of solution. Ten to 15 females were exposed in each dish for 90 minutes, and then transferred to clean cages. The mortality was determined after 24 hours. All tests were made at 80° F.

The results of these tests are given in Table 3. The amounts of malathion residue required for LD-50 and LD-90 against *tarsalis* females from the Fresno District were 93 and 100 times greater, respectively, than for females collected from untreated areas.

CONCLUSION.—Application of malathion emulsion in the Fresno Mosquito Abate-

TABLE 3.—Percent mortality of *Culex tarsalis* females after 90 minutes' exposure to malathion residues. (Average of 7 replications.)

From Treated Areas		From Untreated Areas	
Mg./sq. ft.	Percent Kill	Mg./sq. ft.	Percent Kill
14	88	0.15	70
10	55	.1	66
8	50	.07	50
6	39	.05	25
5	31	.025	9
4	18	..	..
3	12	..	..
2	13	..	..
LD-50	7.3 p.p.m.	..	0.078 p.p.m.
LD-90	21.0	..	.21

ment District of California during 1954–56 caused resistance to develop in both larvae and adults of *tarsalis*. A 90 percent larval kill now requires 33 times more malathion, and use of this larvicide is no longer practical against this species. Malathion is still effective against *nigromaculis*, and parathion is effective against both species. The absence of any resistance to parathion in either species in the Kern district after continued use of EPN and parathion since 1951 indicates that resistance to parathion may develop more slowly or not at all. *C. tarsalis* adults from the Fresno district were about 100 times more resistant to malathion than larvae from untreated areas.

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THE EFFECTS OF SURFACE TENSION ON MOSQUITO DEVELOPMENT

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It has been known for many years that surface tension phenomena play an important role in the development of aquatic insects. Mosquitoes, which undergo most of their developmental cycle in water, are likewise known to be affected by changes in the surface tension of their aquatic environment. It appears however, that the limited number of studies on this subject have been confined largely to larvae (Renn, 1941; Russell and Rao, 1941), and that little attention has been given to the subsequent developmental stages and their responses to a wide range of surface tensions.

The present report compares the effects of different surface tensions upon the development of a variety of genera and species of mosquitoes.

MATERIALS AND METHODS. The pupae of five mosquito species, *Aedes aegypti, Culex fatigans, Culex molestus, Culex pipiens* and *Anopheles quadrimaculatus*, used in these experiments were taken from laboratory colonies reared at 25° C. on a standard diet of dog chow. Also included was a strain of *Culex fatigans* (F) collected from a local sewage drainage ditch as fourth stage larvae and pupae. Using Tween 80 to lower the surface tension and magnesium chloride to raise it, solutions with a surface activity of 31, 41, 45, 53, 72, 73.5, 76 and 78 dynes/cm were prepared. Fifty newly-formed pupae

of each species were placed in cups containing 100 cc. of the test solution. Two days later, all cups were checked for pupal mortality and adult emergence. The results were tabulated in terms of pupal mortality and degree of emergence of the adults (complete and incomplete). All experiments were done twice on different days at 25° C.

Results. The results are summarized in Figure 1 according to the degree of development reached in water at different surface tensions. The data are given in terms of (1) pupal mortality rates, (2) incomplete emergence of the adults (unable to leave the water surface) and (3) complete or normal emergence. All figures not designated in the text as percent refer to dynes per centimeter of surface tension.

It is evident from Figure 1 that none of the species studied can emerge when the surface tension is 41 or less, or 78 or more. At 31 and 78 there was total pupal mortality. However, at 41, *A. aegypti, C. fatigans, C. fatigans* (F), *C. molestus* and *C. pipiens* showed some emergence although it was incomplete. At 45, *C. fatigans* was the only species which exhibited more than 50 percent emergence. There was 69 percent pupal mortality and 31 percent incomplete emergence in *A. quadrimaculatus* at this same surface tension. *Culex fatigans, C. fatigans* (F), *C. molestus* and *C. pipiens* developed well at 53 with only 1, 0, 3 and 8 percent pupal mortality respectively and 7, 8, 19 and 14 percent incomplete emergence. At this same surface tension *A. aegypti* and *A. quadrimaculatus* exhibited 38 and 36 percent emergence respectively. While *A. aegypti* showed no pupal mortality, *A. quadrimaculatus* exhibited 41 percent. At 72, which is the normal surface tension of water at 25° C., there was 100 percent emergence of *A. aegypti, C. fatigans, C. fatigans* (F) and *C. molestus*. However, somewhat fewer of the *C. pipiens* and *A. quadrimaculatus* (92 and 82 percent respectively) underwent normal development. Above 72 the species behaved differently. For example, at 73.5, *A. aegypti* developed well with 96 percent normal emergence. On the other hand, *C. fatigans, C. pipiens* and *C. fatigans* (F) with 82, 82 and 76 percent emergence respectively, showed some inability to adapt to this same surface tension. *Culex molestus* and *A. quadrimaculatus*, exhibiting 53 and 58 percent emergence respectively were even more adversely affected. Significantly more *A. aegypti* completed development at 76 than any other species.

Discussion. Pupae of the six mosquito strains tested, *A. aegypti, C. fatigans, C. fatigans* (F), *C. molestus, C. pipiens* and *A. quadrimaculatus* seem to differ in their ability to withstand different surface tensions. *A. quadrimaculatus* evidently is the least adaptable, having a very limited range (53–73.5) in which normal development is possible. These findings are in accord with those of Renn (1941), who observed that the surface tension of natural breeding water of *A. quadrimaculatus* and *A. crucians* ranged from 65 to 73. Similarly, forty *Anopheles* breeding places studied by Russell and Rao (1941) ranged in surface tension from 65.5 to 70.6.

The four *Culex* strains reacted similarly to a variety of surface tensions. They are more capable of surviving in water having a lower surface tension (45 to 53) than the other species. On the contrary, *A. aegypti* evidently does better at a higher surface tension (73.5 to 76) than any other species tested.

These differences in the behavior of the three genera towards the surface tension seem to be in accord with their natural habitat. It has been pointed out that *A. aegypti* and *A. quadrimaculatus* prefer clean water for development whereas *C. fatigans, C. molestus* and *C. pipiens* all generally breed in polluted water (Horsfall, 1955). Since the surface tension of polluted water tends to be comparatively low, it is not surprising that *Culex* mosquitoes are capable of withstanding lower surface tensions than *A. aegypti* and *A. quadrimaculatus*. It can readily be seen from the results that there is no significant difference in the reaction of the two *fati-*

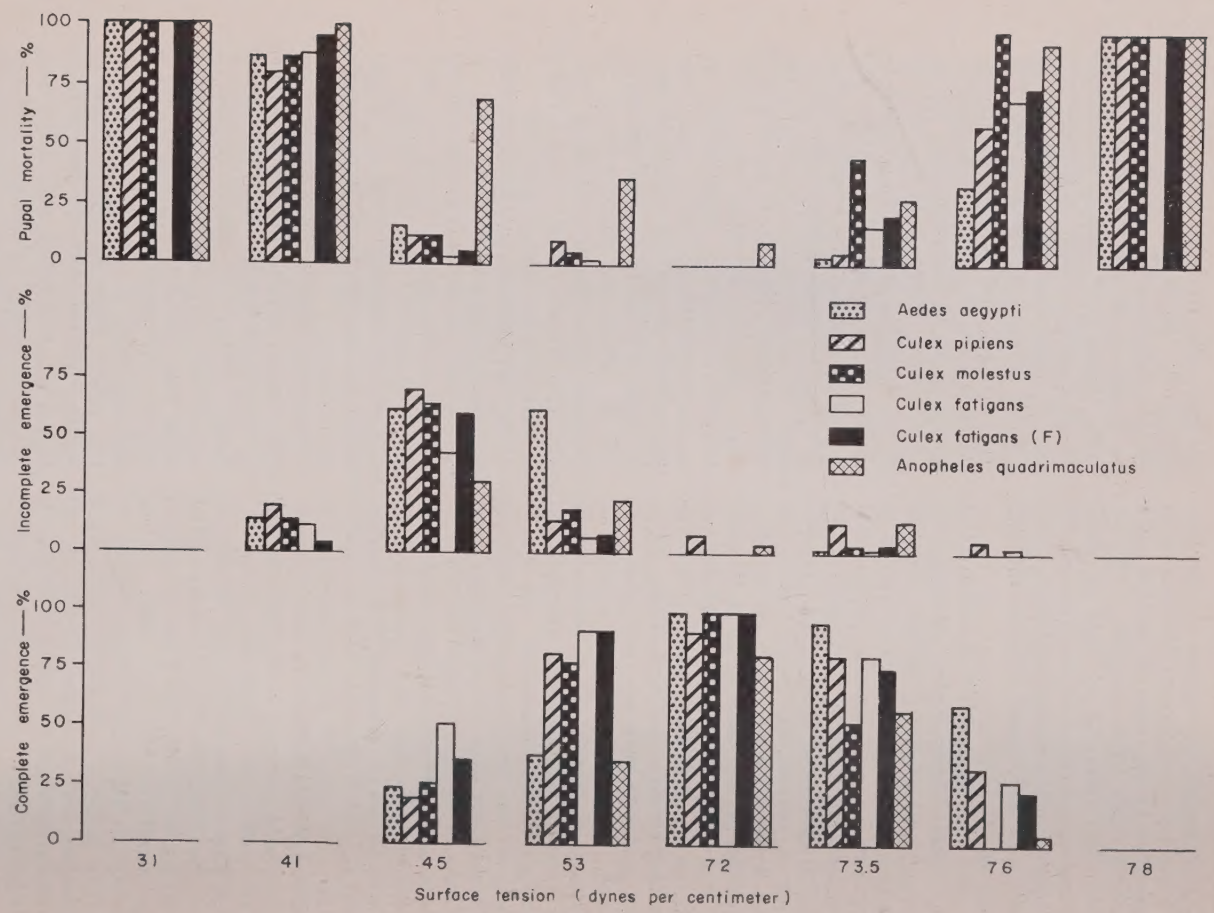

FIG. 1.—Six strains of mosquitoes are compared as to their ability to survive as pupae and complete development while subjected to a wide range of surface tensions.

gans strains to different surface tensions. This finding suggests that factors governing the surface tension requirements of the species are probably inherent rather than a matter of adaptation to a particular environment.

In examining the effects of surface tension on the degree of development, it is interesting to note that it is only at the lower surface tensions, particularly 45, that the largest numbers of all species fail to emerge completely and leave the water surface (see Figure 1). The reason for this may be that at a lower surface tension, the pupae manage to remain at the surface and emerge, but there is very little support for the adult to spread out its wings and body in a normal manner. The adult, therefore, may develop normally, but may lack the necessary support to leave the water surface. On the other hand, at higher surface tensions, the pupae cannot get through the water surface and thus die in the pupal stage. Even though the surface tension of the water at any given time may be optimum for larval growth and development, it may change radically during the pupal period, and interfere with the emergence of the adults.

SUMMARY. The effects of various surface tensions upon pupal development and adult emergence were studied in six strains of mosquitoes. *Culex pipiens, Culex fatigans, Culex fatigans* (F) and *Culex molestus* were found to develop normally in water with lower surface tensions whereas *Aedes aegypti* was found to prefer higher ones. *Anopheles quadrimaculatus* was the least adaptable to changes in surface tension, showing a limited range (53–73.5 dynes/cm) in which normal development could occur.

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A PRACTICAL, LONG-LASTING EMULSION TYPE LARVICIDE

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From the start of mosquito control it has been the dream of mosquito control workers to find a long-lasting larvicide—one that would remain effective for weeks or months. I think we all now realize that this is a hope unlikely to be fully satisfied, primarily because the forces of nature will in one way or another defeat our purpose.

During the war, I first started experimenting with a method of making such a larvicide, and finally, about four years ago, with the encouragement of Mr. LeRoy Kinsey, Deputy Commissioner of Public Works, in charge of the Mosquito Control Division, the idea was further developed and the larvicide put into use. The basic principle, while not unknown, is one that seems to have been overlookd in compounding emulsion larvicide concentrates. We do not call attention to it as a 100 percent perfect larvicide, but as one that merits consideration. After experiencing the advantages and shortcomings of all types, we have found it to be the most satisfactory for general use.

The larvicide is in the form of a semi-stable emulsion, and because it can be compounded on the job, it is relatively inexpensive. Most DDT and other emulsion concentrates are heavier than water and break quickly. When diluted with water for spraying they settle and break in the spray tank, necessitating frequent agitation, and when applied to a breeding area, within an hour or so start to settle in the water, toward the bottom, where they become lost and ineffective amidst the debris and mud.

Emulsions are made up of oil globules floating submerged in water. Generally speaking, there are three factors that determine emulsion stability: (1) the suitability of the emulsifying agent; (2) the globule size, which is determined by the amount and type of emulsifier, and also by the amount of agitation; and (3) the specific gravity of the oil phase. It is this third factor that we utilize.

If the oil globules have the same specific gravity as the water, they will neither rise nor sink. Perfect specific gravity balance (S.G. 1.00) is difficult, and indeed we believe it advantageous to keep the oil phase slightly lighter than water, that is, about S.G. 0.990–0.995. This has several advantages: first, there is a tendency for the larvicide to remain nearer the surface; and second, in case it is made slightly too heavy, it will not so readily settle out. Before going into details about compounding this larvicide, let me say that it is not difficult, and well within the capability of any mosquito control agency, provided, of course, that a careful and reasonably intelligent man is assigned to the job. The only special equipment needed is a precision type hydrometer about 12" long having a specific gravity range from 0.94 to 1.000 (e.g., Will Corp. #16741), and a hydrometer jar. The use of the latter is advisable, especially at first, because otherwise, should you get your mixture too light, the hydrometer will sink to the bottom of the vat, and you will have a messy job recovering it. Two other hydrometers are also useful, one having the S.G. range from 0.850 to 1.000 (Will Corp. #16756) and the other with a range from 1.000 to 1.200 (Will Corp. #16761).

Regarding the actual mixing, let us assume that we wish to make a DDT emulsion concentrate. Three ingredients are needed:

1. A DDT concentrate (about 30 percent DDT in an aromatic petroleum solvent). It is necessary that the specific gravity of this material be greater than water. Most of them range from S.G. 1.04 to 1.12.
2. A suitable emulsifier.
3. #2 fuel oil.

The trick is to add fuel oil to a mixture of DDT concentrate and emulsifier

to bring down the specific gravity to the desired point. I have worked out and utilize mathematical formulas which give the necessary proportions, but actually they can be found easily by trial and error, preferably on a small scale at first until some idea of the proper proportions is reached. In Table 1 are listed the approximate

TABLE 1.—Example of approximate proportion of components of larvicide emulsion concentrates.

30% DDT concentrate, S.G.	1.040	1.080	1.12
	Gal.	Gal.	Gal.
30% DDT concentrate	28.0	23.5	20.0
#2 Fuel oil (S.G. .0852)	10.5	15.0	18.5
Triton X 171	1.5	1.5	1.5
	40.0	40.0	40.0
Approx. percent DDT by weight	22%	19%	17%

proportions for DDT solutions of various specific gravities as a starting point. As 40 gallons is a convenient amount to mix in a 55-gallon drum, the figures are for this amount. They can be reduced in proportion if you wish first to experiment in your laboratory.

After mixing to the above proportions and stirring well, take a hydrometer reading. If too high, add more fuel oil, if too low, more DDT concentrate. The actual amount must be learned by experience. It is best to add a little at a time, stirring and taking readings between each addition until the desired gravity is reached. If careful notes are kept they will form a basis for more rapid and accurate mixing of future batches. It should be realized however that the success of this larvicide depends on the close control of the specific gravity, therefore each batch should be checked and the gravity corrected if necessary. This is important for two reasons; human error and variations in different batches of ingredients. If the mixing is done at the prevailing outdoor temperature, and if the material is used within a reasonably short time, this will provide all the temperature correction that is necessary and practical.

It should be observed that this idea is equally applicable to other emulsifiable toxicants or toxicant solutions, also for controlling other types of aquatic animal or plant life.

While the stability of commercial emulsions can frequently be greatly improved by decreasing the gravity by this method, we have found it desirable to start with a DDT concentrate oil solution and adding our own emulsifying agent as we can thereby use the type and quantity we have found to be most suitable and economical. There are literally hundreds of different emulsifiers made for hundreds of different purposes. For this reason an emulsifier must be selected for the particular job it is to do. Emulsifiers that work well for us may not work as well with other water conditions. Emulsifiers that are satisfactory for a DDT aromatic petroleum solution may work quite poorly with other materials. Therefore, when seeking an emulsifier, one should seek the advice of reliable manufacturers, informing them exactly what materials are to be used, the nature of the water in which they will be used, and what is to be accomplished. Finally, when there is a choice of several different emulsifiers it is worthwhile to take the trouble to run small scale stability tests. As the Rohm and Haas Company have been especially active in the insecticide field, and most cooperative in providing information and samples, we have been using their products. During the past year we used their Triton X-171 for our general purpose larvicide, and a smaller quantity of X-161 for a special salt water emulsion. In their literature this company points out that where water hardness is encountered better results can frequently be obtained by using various combinations of their X-151, X-161 and X-171 emulsifiers. We use approximately 4 percent by weight, based on the estimated quantity of the finished product. It is added to the 30 percent concentrate first, then the fuel oil

is added to bring the mixture down to the desired specific gravity, as previously explained.

This material, when diluted 1 part to 9 parts water, makes a larvicide emulsion for spraying containing approximately 2 percent DDT by weight. It will remain in the spray truck tanks for several weeks without noticeable creaming or breaking, and when sprayed onto the breeding area, it becomes intimately mixed with the water. For this reason, when treating a large, deep, breeding pool, the total volume of water must be taken into account if a residual effect is desired. If valuable fish are present, extra care should be used.

As this article deals primarily with a specfic type of larvicide emulsion, rather than with the toxicant used, I will not go into details regarding the results obtained in Nassau County. It is sufficient to say that we still find DDT satisfactory, although resistance has undoubtedly developed in some locations. The highest resistance is found among the *Culex pipiens,* in some cases requiring as much as 3 to 4 parts of DDT to 1,000,000 parts water for a complete kill. During the past summer we used this larvicide in an old water-filled sand pit now being used as a town rubbish dump. Using approximately 1 part DDT to 1,500,000 parts water by weight, we obtained an average of three weeks control before larvae again appeared. Considering the probability of resistance, this was a relatively weak dose. Like most emulsions, it cannot be depended upon to kill pupae. In recent tests, high gamma BHC has shown a definite superiority over DDT.

Among other tests made was one using a heavy aromatic petroleum product to make an emulsion concentrate having a gravity of .99 without the addition of a toxic agent. The purpose was to find out if the oil emulsion alone would give a satisfactory kill. Even at concentrations as high as 1 part to 50,000 parts water, it did not do so.

I mentioned previously a special emulsion concentrate for use with salt water. This is supplied to our boat crews. When diluted 1 part to 9 parts bay or ocean water for spraying, it will remain stable for several hours or even days. When sprayed on brackish water, it tends to rise to the surface and break in a period of hours or days, depending upon the total amount of salts present. I have been watching this carefully and the boat crews all report satisfactory kills. As a residual effect cannot be expected on tidal marsh areas, the lack of long period stability is not serious.

One of the factors I mentioned which affects the stability of an emulsion is the amount of agitation with which the oil and water phases are mixed. For best results this factor must be taken into account. If they are just poured together a spontaneous emulsion will result, but the more they are agitated as they are mixed, the better the result will be. At least they should be paddled vigorously while they are being mixed and for a short time after, or better yet, direct a jet of water against the emulsion concentrate as it is being poured into the tank. The stream from the filling hose or spray pump can be used for this purpose.

We would be pleased to hear from any agency that utilizes the idea here presented; either to answer questions, or to learn of results.

SUMMARY. This article brings to the attention of mosquito control workers a tested, practical method of making an improved larvicide emulsion, which because of its greater stability has a considerably longer effective life than those now in general use. Sufficient details are given in order that it can be mixed and utilized satisfactorily by any mosquito control agency with commonly used equipment.

INVESTIGATIONS ON THE BIONOMICS OF *CULICOIDES OBSOLETUS* (MEIGEN) AND OTHER BITING MIDGES AT MOUNT SOLON, VIRGINIA *

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In the Shenandoah Valley near Mount Solon, campers and staff members at a Girl Scout camp have experienced severe annoyance from biting midges. An excellent opportunity was provided for studying the biology and ecology of these insects during the summer of 1951. Small shaded streams with sand and mud banks flow through the camp area and into a branch of the North River nearby. The elevation is between 1572 and 1620 feet.

Methods. Three New Jersey light traps were used to collect *Culicoides* adults. Sixteen-mesh wire screening was fitted over the intake end and a double layer of gauze was wrapped about the lower cone of each trap. The traps were operated from just before dusk until an hour or so after sunrise. From June 16 to September 6, the traps were run 51 nights. During 28 nights at least one trap caught over 1,000 punkies, and catches of 7,000 to 10,000 were not unusual. The maximum for one trap in a single night was approximately 45,600. For the most part, the three traps were operated in three general areas within the camp and adjacent to it, but from time to time they were placed in different habitats with respect to vegetation, elevation, proximity to streams and the like.

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Species. *Culicoides obsoletus* (Meigen) comprised upwards of 95 percent of trap catches. Fourteen other species were taken and are listed in order of abundance: *C. guttipennis* (Coquillett), *C. biguttatus* (Coquillett), *C. stellifer* (Coquillett), *C. travisi* Vargas, *C. crepuscularis* Malloch, *C. villosipennis* Root and Hoffman, *C. arboricola* Root and Hoffman, *C. venustus* Hoffman, *C. haematopotus* Malloch, *C. piliferus* Root and Hoffman, *C. variipennis* (Coquillett), *C. nanus* Root and Hoffman, *C. baueri* Hoffman, and *C. spinosus* Root and Hoffman.

Adult Habitats. The adult habitats of *Culicoides obsoletus* are reportedly diverse, but according to the findings of Hill (1947) in England, Jenkins (1948) in Alaska, and Malloch (1915a) in Illinois, woods or woodland areas are preferred. Wirth and Bottimer (1956), in their population study of *Culicoides* in the Edwards Plateau region of Texas, state that *C. crepuscularis* is in greatest abundance in open, unwooded country. They report the muddy margins of stock ponds in pastures as the favored breeding places for *C. variipennis,* and that *C. haematopotus* and *C. arboricola* were among the commonest species in wooded locations. Root and Hoffman (1937) and other authors have reported *C. arboricola, C. guttipennis, C. baueri* and *C. villosipennis* to be tree hole breeders.

By varying the location of the three light traps for 51 nights in the Mount Solon area, and by comparing the resulting incidence of different species, an indication of the preferred habitat of most species was obtained. *C. guttipennis* and *C. villosipennis* were taken at higher forest elevations. Traps operated in, or at the edge of, the forest contained *C.*

obsoletus, C. arboricola and *C. travisi.* Collections from lowland fields and pastures consisted of *C. stellifer, C. crepuscularis, C. venustus, C. variipennis,* and *C. haematopotus. C. biguttatus* was recovered from nearly all forest and lowland habitats.

NOCTURNAL ACTIVITY AND BITING. The activity of most species of *Culicoides* has been reported greatest during the evening and early morning hours. Hill (1947) and Parker (1949) found *C. obsoletus* most abundant in England and Scotland during these hours, but had recorded few for the time between. Pratt *et al.* (1949) discovered similar peaks of activity for Alaskan species, with counts frequently dropping to zero during the middle of the day and at midnight. According to Goulding *et al.* (1949), 87 percent of *C. furens,* and other Florida salt-water species caught in light traps, were taken in the morning hours. Hinman (1936) found that *C. mississippiensis,* another salt-water species, also attacked man readily in the daytime.

To evaluate the little-known nocturnal activity of *C. obsoletus* from a different climate, a light trap was operated in relays during four nights in July and August near Mount Solon. Approximately 45,125 *C. obsoletus* comprised the basis for the following analysis. On two occasions, the catches from 11 p.m. to 5 a.m. were much greater than the total of those from 8 p.m. to 11 p.m. The average percentages for each interval were: 8 p.m. to 9 p.m., 6.75 percent; 9 p.m. to 10 p.m., 11.75 percent; 10 p.m. to 11 p.m., 16 percent; 11 p.m. to 2 a.m., 22.25 percent; and 2 a.m. to 5 a.m., 43.25 percent. (All time is Eastern Standard Time.)

Smaller numbers of *C. guttipennis, C. travisi, C. biguttatus,* and *C. arboricola* also showed increased incidence during the 2 a.m. to 5 a.m. period.

Routine biting counts were taken three times weekly on arms exposed for 15-minute intervals. The identification of 80 specimens thus collected indicated that *C. obsoletus* was outstanding in numbers and in its persistence in entering screened cabins from just before dusk to dawn. (On one occasion a group of people were severely bitten by large numbers of *C. obsoletus* in a lighted, screened cabin from 3:30 a.m. to 4:30 a.m. EST.) *C. biguttatus* bit in lighted buildings during early evening hours. *C. guttipennis* bit aggressively outdoors late in the evening, and *C. stellifer* bit occasionally during the day, apparently flying from emergent and overhanging vegetation along streams.

A study of recorded area climatological data and biting records showed that wind velocity greater than three to five miles per hour inhibited biting. Temperature increases or decreases of at least several degrees, and high humidity appeared to stimulate biting activity.

SEASONAL OCCURRENCE. The seasonal occurrence of many fresh-water *Culicoides* corresponds with two generations per year, whereas some salt-marsh species are observed throughout the year along Atlantic and gulf coasts. Hoffman (1925) in the Eastern United States, and Root and Hoffman (1937) in the Middle West record *C. obsoletus* from May to October, while Malloch (1915) recorded it during April and up to November. Hill (1947) and Edwards (1939) in England found peaks of *C. obsoletus* in early June and September with declining numbers in October. Foote and Pratt (1954) give the earliest and latest monthly record for the following species in Eastern United States: *C. obsoletus,* January 18 (1949) and November 29; *C. biguttatus,* March 30 (1949) and September 17 (1914); *C. stellifer,* January 20 (1947) and August 29 (1945); *C. guttipennis,* March 30 (1948) and August 31; *C. venustus,* Januray 20–21 (1945) and December 27 (1947); *C. travisi,* April 8 (1949) and July 25 (1942); *C. haematopotus,* January 14 (1947) and September 14 (1942); *C. crepuscularis,* April 8 (1948) and September 4 (1945); *C. piliferus,* April 26 (1948) and July (1944); and *C. arboricola,* March 28 (1949) and August 8 (1945). Earlier and later monthly records on some of these

species have been reported by Wirth and Bottimer (1956) from the Plateau Region of Texas.

An index of seasonal occurrence of the various species at Mount Solon was derived from an analysis of trap data from June 16 to September 6. *C. obsoletus* numbers rose sharply twice during the season; from mid-June to mid-July, and again from July 20 to mid-August. Over 200,000 specimens comprised these crests. *C. biguttatus* and *C. stellifer* showed a high incidence of several hundred from mid-June to mid-July with smaller numbers taken in the weeks between and following this period. Thirteen *C. stellifer* were trapped September 5. Thirteen thousand fifty eight *C. guttipennis,* 183 *C. villosipennis,* and 101 *C. venustus* were taken from the last week in June to mid-July with smaller numbers of the former two species in late July, early August, and early September. Twenty *C. guttipennis* and four *C. villosipennis* were recorded from one trap on September 6. *C. venustus,* however, appeared infrequently in August, but 14 were caught September 5. A few *C. travisi* were collected from mid-June to mid-July with high catches of 33 and 79 on June 27 and July 2. Of these, seven were also collected July 27 and two August 7. Ten *C. haematopotus* occurred late in June and nine late in July. Most of 260 *C. crepuscularis* were trapped during the last week of June and until mid-July; however, two specimens were taken on September 5. Two *C. piliferus* were caught on June 22, and 13 more between July 13 and 15. A well defined increase comprised of 52 *C. arboricola* was obvious during the second week of July as was another by 96 specimens July 25 through August 31.

Breeding Areas. The larvae of *Culicoides* are found in mud, sand, and debris at edges of ponds, lakes and creeks and in treeholes. Hill (1947) recovered *C. obsoletus* larvae from clayey soil, decaying leaves in a treehole and from a shady ditch full of rotting leaves, but no definite opinion could be formed as to the nature of essential features of the breeding media. *C. arboricola, C. guttipennis, C. villosipennis* and *C. nanus* have been reported by Root and Hoffman (1937) and others as typically treehole breeders. Wirth and Bottimer (1956) reared *C. baueri, C. crepuscularis, C. haematopotus, C. spinosus, C. stellifer,* and several other species from pond-edge mud samples in Texas.

The study of breeding areas in Mount Solon centered primarily around 71 locations along or near the small forest streams. Forty-five preliminary mud, sand, and humus samples yielded 92 pupae of six species which were reared to adults and identified. They included: 23 pupae of 14 female and nine male *C. haematopotus* collected in two locations between July 5 and August 23; 10 pupae of six female and four male *C. stellifer* collected in two locations between July 7 and July 12; seven pupae of six female and one male *C. biguttatus* collected from six locations between June 25 and July 6; eight pupae of six female and two male *C. piliferus* collected in five locations between June 25 and July 7; 37 pupae of 26 female and 11 male *C. guttipennis* collected in three treeholes between July 30 and September 29 (collecting from treehole debris continued several weeks after field work was concluded); and seven pupae of five female and two male *C. obsoletus* collected from two treeholes July 2 to September 7.

As indicated by soil sample results, inverted cans fitted with glass vials having tin-foil cones were distributed throughout the areas of known or suspected *Culicoides* breeding. Thirty-two can traps captured 183 adults. These included: 160 adults of 97 female and 63 male *C. haematopotus* trapped in three locations between July 12 and September 3; one adult female of *C. stellifer* trapped in one location on July 29; two adult males of *C. biguttatus* trapped in two locations on June 25; and 20 adults of 14 female and six male *C. obsoletus* trapped in four locations between July 12 and September 7. Can traps were not used at treeholes.

FIG. 1.—Stream edge habitat of immature *Culicoides haematopotus*. (Can trap circled.)
FIG. 2.—Stream bed area from which *Culicoides stellifer* adults and pupae were taken. (Can traps circled.)
FIG. 3.—Marginal stream pocket where *Culicoides piliferus* pupae were collected.
FIG. 4.—Vegetated stream margin habitat of immature *Culicoides biguttatus*. (Can traps circled.)
FIG. 5.—Water-filled treehole from which *Culicoides guttipennis* larvae and pupae were collected.
FIG. 6.—Compost heap of damp leaves which yielded adult *Culicoides obsoletus*. (Can traps circled.)

By comparing the incidence thus obtained, with the type location, conclusions were made concerning the preferred larval habitats of several species. *C. haematopotus* was found a few feet from the stream edge in damp sand containing leaf mold (Fig. 1). The soil temperature averaged 75° F. as shade was incomplete during the day. *C. stellifer* was taken from shallow stream-edge depressions lined with black decaying leaves (Fig. 2). All sites were well shaded and soil temperatures averaged 71° F. *C. piliferus* preferred relatively clean moist sand in well shaded locations (Fig. 3). Soil temperatures averaged 67° F. *C. biguttatus* was recovered from several well shaded places along the streams which included sand that supported vegetation and muck, rich in decaying leaves (Fig. 4). Average soil temperature was 68° F. *C. guttipennis* was taken from water-filled treeholes in which water temperature averaged 70° F. (Fig. 5). A few *C. obsoletus* were found in treeholes rich in decaying matter and in sandy stream banks devoid of humus. The majority of *C. obsoletus,* however, came from two shaded compost heaps of damp leaves dumped near the streams (Fig. 6). Temperature of breeding media averaged 71° F.

Summary. During the summer of 1951 a study of the *Culicoides* of the Mount Solon, Virginia, area was conducted in order to determine their biology and ecology. Three light traps were operated 51 nights from June 16 to September 6. *C. obsoletus* represented 95 percent of the trap totals; however, 14 other species were collected. By comparing the kinds trapped in each type of environment, the preferred adult habitat of several species was determined. *C. guttipennis* and *villosipennis* were found only in high forest elevation, and *obsoletus, arboricola* and *travisi* in or near forest areas. Lowland fields and pastures were inhabited by *stellifer, crepuscularis, venustus, variipennis* and *haematopotus.* On four occasions a light trap was run in relays from dusk to dawn. Twice the catches of *obsoletus* from 11 p.m. to 5 a.m. were much greater than those from 8 p.m. to 11 p.m. Other species also showed increased activity during the late night and early morning hours. *C. obsoletus, biguttatus* and *guttipennis* were the primary nocturnal biters, while *stellifer* bit occasionally during the day. There were two general increases in *Culicoides* numbers during the study; one from mid-June to mid-July, and the other from late July to mid-August. Several species appeared in smaller numbers during late August and early September. Breeding areas were determined by rearing pupae from soil samples and by trapping emerging adults. All species required moisture and some shade, and most preferred sand rich in humus. *C. obsoletus* was taken in numbers from sand, compost heaps of leaves, and from treeholes.

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NEW MOSQUITO DISTRIBUTION RECORDS FROM OKINAWA

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In their initial survey of Okinawa, Bohart and Ingram (1946), listed 8 genera and 33 species of mosquitoes from this island. Bohart (1955) described an additional species of *Culex* from Okinawa, bringing the total number of species to 34. This note reports the collection of three species of mosquitoes not previously recorded from Okinawa.

(1). *Orthopodomyia anopheloides* (Giles). 20 April 1955 (collected by T. Nakata), 13 fourth instar larvae from a tree stump, 7 kilometers west of Ada Village, Okinawa.

(2). *Toxorhynchites sp.* 20 April 1955 (collected by T. Nakata), 1 fourth instar larva from a tree stump, 7 kilometers west of Ada Village, Okinawa. Collected in association with *Orthopodomyia anopheloides* (Giles). This specimen has been deposited in the U. S. National Museum.

(3) *Mansonia ochracea* (Theobald). 16 September 1955 (collected by Entomology Branch, Office of the Surgeon, RYCOM), 1 female from a New Jersey type light trap, ¼ mile southwest of Oyama, Okinawa. Subsequent collections during June, July and August, 1956, revealed the presence of this species at Awase and Shimabuku, Okinawa.

The author is indebted to Dr. R. M. Bohart, Dept. of Entomology, University of California, Davis, California, for verification of indentifications.

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AN APPARATUS AND TECHNIQUE FOR THE CONTINUOUS ANESTHETIZATION OF HAEMATOPHAGOUS INSECTS WITH DRY ICE

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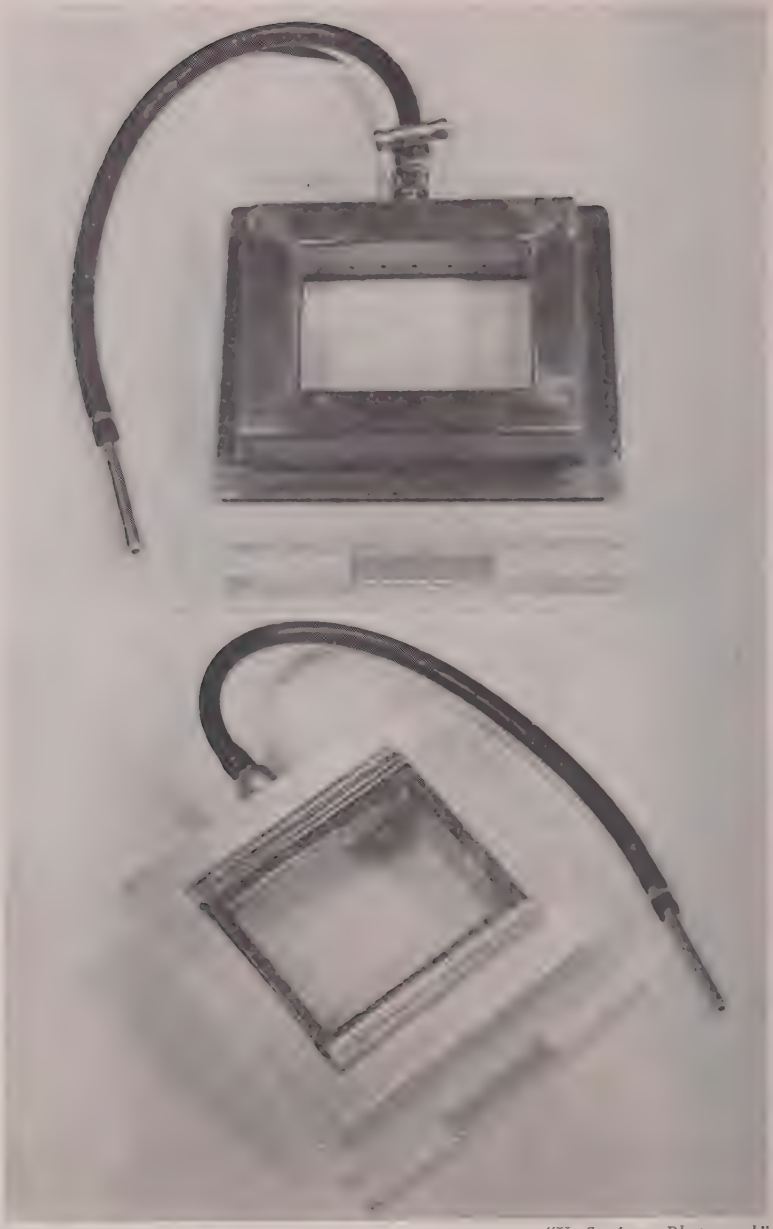
Carbon dioxide has been used for a long time as an anesthetic in entomological research. In their studies on the genetics of *Drosophila,* l'Heritier and Teissier (1937) routinely employed carbon dioxide for anesthetizing these flies. Williams (1946) and Willis and Roth (1949) have described techniques for anesthetizing small insects with carbon dioxide. Maramorosch (1953) used carbon dioxide in handling leafhoppers in his transmission studies of plant viruses by these insects, and, in 1956, described a technique for anesthetizing insects with carbon dioxide so that he could inject them with viruses and other substances. Caldwell (1956) employed dry ice for anesthetizing house flies for toxicological studies. In studying the effects of different anesthetics on the behavior of honey bees, Ribbauds (1950) concluded that carbon dioxide and nitrogen stop respiration; whereas ether and chloroform affect the nervous system.

Though the above mentioned works all utilized carbon dioxide in one form or another for the anesthetization of different insects, none of the insect chambers used for these studies made use of transmitted light, which the author found invaluable in the work of separating live unfed arthropods from blood-fed arthropods. Therefore, a new carbon dioxide anesthetizing chamber, or "arthropod stunner," was designed. The equipment of Willis and Roth is somewhat similar in design to the arthropod stunner in that the anesthetizing chamber can be fitted into the grooves of the stage of a dissecting microscope, but their apparatus does not have a transparent bottom and several other features are somewhat different.

[1] Assistance of the following persons is gratefully acknowledged: Mr. Earl Oden, Mr. Joseph Carroll and Mr. Robert Castle.

The arthropod stunner is basically a topless, rectangular stainless steel box with a partial glass bottom (Fig. 1A). A tube, rectangular in cross-section, ¾ inch wide by 1 inch high, through which the carbon dioxide is piped, forms the four sides of the box. The floor of the box is 6¼ inches long by 5⅛ inches wide. The tube is set in 5/16-inch from the edge of the floor so that a flange extends out from it; this flange slips into the grooves of a dissecting microscope normally used to hold the glass stage. The bottom of the inside of the anesthetizing chamber is of glass. This glass piece is secured tightly against a soft rubber gasket with two metal strips screwed to the underside of the metal portion of the bottom (Fig. 1B). In the side wall of the tube toward the chamber, just above the glass bottom, are 28 holes, each ⅛-inch in diameter. These holes are screened on the inside of the tube with 80-mesh stainless steel screen cloth. There is a ⅛-inch needle valve welded into one of the long outside walls of the tube. Rubber tubing connects this inlet with the rubber tubing leading from the carbon dioxide supply.

The carbon dioxide used in these studies was obtained by placing crushed dry ice in a reagent bottle and piping off the gas that formed as the dry ice evaporated at room temperature, through a second reagent bottle half filled with water, and then into the anesthetizing chamber (Fig. 2). The water bottle is used only so that the worker can be sure (by the bubbles produced in the water) that the carbon dioxide supply is flowing freely from the first bottle. A 1,000 cc. reagent bottle half filled with crushed dry ice will produce enough carbon dioxide to last for approximately five hours.



"U. S. Army Photograph"

FIG. 1A.—(Above) Top view, Arthropod Stunner.
FIG. 1B.—(Below) Bottom view, Arthropod Stunner.

Commercially tanked carbon dioxide may be used with the arthropod stunner; however, the writer found dry ice more suitable since it was always available and there was never the danger of the gas supply being exhausted in the middle of an experiment. More important, the great pressure under which the carbon dioxide gas is tanked commercially makes it difficult to obtain a slow, steady release flow even with a valve system. Sometimes when tanked gas has been used the flow has been so strong as to blow the arthropods out of the anesthetizing chamber.

The glass bottom of the anesthetizing chamber enables one to use the arthropod stunner with a mirror-equipped dissecting microscope. Light transmitted from beneath illuminates the digestive tract so that it can be viewed with ease and even the slightest amount of blood within the tract of a fed insect can be detected. When light is directed on the top or side of a blood-fed insect the digestive tract is darkened to such a degree that it is most difficult to determine whether the insect has taken in blood.

The apparatus and technique have been used successfully with blood-fed fleas (*Xenopsylla cheopis*) and mosquitoes (*Aedes aegypti*). Fleas can be anesthetized for several hours and mosquitoes for two hours with carbon dioxide without lethal effects.

SUMMARY. A continous anesthetizing apparatus ("arthropod stunner") that has been especially designed to utilize transmitted light in separating live unfed from blood fed arthropods has been described. Carbon dioxide obtained from dry ice has

"U. S. Army Photograph"

FIG. 2—Assembled Arthropod Stunner and carbon dioxide supply.

been used as the anesthetic for fleas (*Xenopsylla cheopis*) and mosquitoes (*Aedes aegypti*).

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AN ADDITIONAL UNITED STATES RECORD OF *HAEMAGOGUS EQUINUS*

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Following the report by Trapido and Galindo (1956) of the recovery of *Haemagogus equinus* from near Brownsville, Texas, we have made extensive efforts to determine its distribution and prevalence. The presence in the United States of this mosquito implicated as a reservoir and transmitting agent of jungle yellow fever in Central America is of considerable interest even though monkeys, the primary vertebrate hosts, are not indigenous. Other animals, notably several species of marsupials, have been shown to be susceptible to experimental infection with the yellow fever virus (Strode, 1951). Numerous species of wild animals abound in the Brownsville area including a marsupial, *Didelphis marsupialis*.

Brownsville, with an elevation of 16 feet, is located at the extreme southern tip of Texas about 18 miles west of the Gulf of Mexico. The alluvial soil was deposited by the Rio Grande River which separates the contiguous populations of Brownsville and Matamoros, Mexico. The semiarid area has an average rainfall of only 29.55 inches. The precipitation is poorly distributed with the maxima in May, June and September; frequently a single thunderstorm will account for a month's rainfall.

The estimated 1955 population of Cameron County was 148,952, with a majority of the residents engaged in irrigation agriculture. Principal products are citrus, vegetables and cotton. Normal temperatures during the summer and fall are in the lower nineties in the daytime and middle seventies at night; during February, the coldest month, the normal daily minimum is only 52° F.

It is the purpose of this paper to recount the circumstances concerning our collection of *H. equinus* together with a list of the other species of mosquitoes recorded from Cameron County. Collections of *equinus* were made by Trapido and Galindo from 2 locations on September 4 and 6, 1956. Over 8 inches of rain had fallen in Cameron County during the latter part of August and the first few days in September mainly as a result of a minor and 2 major hurricanes that moved into the Mexican coast 150–300 miles south of Brownsville.

Following publication of this informa-

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"Photo Texas State Department of Health"

Fig. 1.—Utilizing siphoning device to remove *Haemagogus* larvae from tree hole.

tion a continuous search has been made for *Haemagogus* in South Texas by personnel of the United States Public Health Service Quarantine Station in Brownsville, supplemented by several field trips by investigators of the State Health Department and other agencies.

The week beginning June 18, 1956, 20 representatives from the International Cooperation Administration, U. S. Public Health Service, Pan American Sanitary Bureau, the Texas State Department of Health and the Mexican Ministry of Health made an extensive mosquito survey of the Brownsville—Matamoros area with particular reference to yellow fever vectors. A 2-inch rain fell on June 18 in scattered areas in Cameron County and filled tree holes in some of the thorn scrub. Several hundred tree hole breeding larvae were taken but all were *Aedes triseriatus* and *A. zoosophus*. *Aedes scapularis* were biting freely in the shaded areas and an occasional *A. bimaculatus* was noted.

It was not until March 5, 1957, that we were able to duplicate the findings of Trapido and Galindo. At that time, 10 days after heavy rains, *Haemagogus equinus* pupae were collected from a tree hole about 4 feet from the ground in a Texas ebony, *Pithacolobium flexicaule*. The tree was not a large one—only some 15 feet high and 8 inches in basal diameter. The tree hole was 8 or 10 inches deep and was smaller than one's fist. (Fig. 1). When full, it would probably hold a pint of water, but at the time we drained it only about half this amount was taken. The collection locale was some 16 miles from Brownsville on the Boca Chica beach road and was apparently in the same vicinity as one of the 2 original recovery sites.

The tree from which the pupae were taken was in a fairly thick stand of thorn scrub; entry would have had to be effected by means of a machete or other cutting tool except that trails had been hacked out to most of the Texas ebony trees scattered about in the brush in order that the leaf mold under these trees might be removed for use in dressing lawns and flower beds. Other plants in the area are *Karwinskia humboldtia, Zizyphus obtuuifolia, Phaulothomnus spinescens, Prosopis juliflora,* and *Yucca* spp.

We spent a considerable amount of time sitting motionless in the area at ground level but were not attacked by *Haemagogus*. It scarcely seems likely that they are canopy feeders under these conditions as the tree holes are only a few feet off the ground. Mosquitoes should have little difficulty in obtaining blood meals as a variety of potential hosts were seen, including a large bird fauna, *Neotoma* rats, *Peromyscus* mice, domestic cattle, horses and a coyote. Raccoon tracks were common in the brush and opossums are said to be prevalent. This section is sparsely settled, with only one farm home within miles of the *Haemagogus* collection site.

The significance of the presence in Texas of this mosquito implicated as one of the reservoirs and transmitting agents of jungle yellow fever is difficult to evaluate. Our studies would indicate that large populations are not likely to develop due to the constantly decreasing acreage of thorny brush and the semi-arid climate.

The spread of yellow fever into Mexico which appears imminent might well have serious economic consequences in both the United States and Mexico. A quarantine would probably restrict the movement of Mexican National contract laborers who are brought to the United States each year. Almost half a million of these agricultural workers from throughout Mexico are utilized in harvesting our crops. Some 100,000 are used in the Lower Rio Grande Valley alone. Texas reception centers are in Hidalgo, Eagle Pass and El Paso and large concentrations of prospective workers congregate in Mexico across from these towns.

These contract workers are given a physical examination prior to admittance to the United States and are housed under supervised conditions, greatly reducing

the possibilities of their introducing exotic agents such as yellow fever virus. A much greater problem is presented by the appreciable number of aliens who cross the Rio Grande illegally. They usually hide in the brush in their efforts to escape the Border Patrol officers. Not infrequently, during our *Haemagogus* surveys we have found these people at their primitive campsites, completely accessible to the bites of mosquitoes.

As a result of favorable ecological conditions, the mosquito fauna of Cameron and adjacent counties is diverse and abundant. Mosquito related diseases have always been troublesome in the area; yellow fever was rampant in the latter part of the 19th. century; a few apparently indigenous cases of malaria are still being reported; an outbreak of dengue involving several hundred cases occurred as late as 1941; and a major outbreak of St. Louis encephalitis was experienced in the late summer and fall of 1954.

Of the 75 species of mosquitoes reported from Texas, 44 have been collected in Cameron County in addition to *H. equinus*. They are: *Culex coronator, C. tarsalis, C. declarator, C. thriambus, C. territans, C. peccator, C. erraticus, C. chidesteri, C. restuans, C. interrogator, C. quinquefasciatus, C. nigripalpus* and *C. salinarius; Psorophora ciliata, P. cyanescens, P. confinnis, P. signipennis, P. discolor, P. longipalpus, P. horrida,* and *P. mexicana; Aedes aegypti, A. sollicitans, A. vexans, A. zoosophus, A. taeniorhynchus, A. nigromaculis, A. thelcter, A. bimaculatus, A. scapularis,* and *A. triseriatus; Anopheles quadrimaculatus, A. bradleyi, A. crucians, A. pseudopunctipennis, A. punctipennis* and *A. albimanus; Uranotaenia lowii; U. sapphirina,* and *U. anhydor; Deinocerites spanius; Mansonia titillans* and *M. perturbans;* and *Culiseta inornata.*

Our current mosquito studies have indicated that *Culex tarsalis* is rare in the Rio Grande Valley. The 1954 outbreak of St. Louis encephalitis was shown to be associated with the prevalent *C. quinquefasciatus.* No *Aedes aegypti* have been found in Brownsville during recent surveys and only an occasional specimen has been taken in the rest of the valley. The *Anopheles quadrimaculatus* index remains high and adults in natural resting places can be found with little difficulty. *A. albimanus* is rarely encountered although it was abundant during the 1940–45 period.

Summary. A second record of the collection of the jungle yellow fever mosquito, *Haemagogus equinus,* in the United States is given, together with a list of the other mosquitoes found in the collection locality.

Acknowledgments. Confirmation of the specific identification of the *Haemagogus* was made by Dr. Alan Stone of the U. S. National Museum. Mr. Dudley Johnson, Cameron County Health Unit, has assisted in the *Haemagogus* surveys as have Mr. F. J. Von Zuben, Mr. R. E. Peal, Mr. J. S. Wiseman and Mr. Neal Herron of the Texas State Department of Health.

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THE STATUS OF MALARIA CONTROL IN THAILAND

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Malaria has long occurred throughout Thailand, being most prevalent in hilly areas where stream conditions offer ideal habitats for the principal vector, *Anopheles minimus*. During 1945–49 reported malaria deaths averaged more than 45,000 annually in a population then approaching 18,000,000. Over half of the population lived in malarious areas and malaria cases were estimated at around 5,000,000 per year. While diagnosis was largely non-professional, subsequent technical surveys have confirmed that malaria has been the major cause of death and debilitation in the kingdom. *Plasmodium falciparum* and *P. vivax* are prevalent in all areas, but the former species usually predominates; *P. malariae* is distinctly rare. *A. minimus* is the only vector known to be effective in maintaining the disease in Thailand.

Malaria control has been an organized national health program since 1930, the work in earlier years depending largely on malaria treatment and self-protection from the disease. The present intensive anti-malaria campaign began in 1950 when the Ministry of Public Health was assisted by WHO (World Health Organization) and UNICEF (United Nations International Children's Emergency Fund) in a pilot project demonstrating residual house-spraying to eliminate malaria transmission. Technical and economic assistance by ICA (International Cooperation Administration) began in 1951 to expand the spraying campaign and supplementary activities into a nationwide program directed toward malaria eradication.

The antimalaria organization currently numbers two ICA advisers, 16 medical officers, and over 300 technical personnel. Several thousand temporary foremen and spraymen are employed during the house-spraying campaign each year. All operations are conducted by the Division of Malaria and Filariasis Control, Department of Health, Ministry of Public Health. The program has been established in 63 provinces, the remaining eight provinces in the kingdom being relatively small in area, with little endemic malaria, and grouped around the capital in the central plains. It is expected that prior to 1960 malaria will be largely eliminated throughout Thailand and a well-developed program of anti-malaria vigilance will continue wholly on the regular Thai Government Budget. The program has reached virtually all malarious areas and directly protects over 10,000,000 population (half of the present national population) with large-scale activities in house-spraying, technical surveys, antimalaria vigilance, malaria treatment, training, and public information.

House-spraying is scheduled during the first half of each year, mainly during the dry season which offers the best field conditions and precedes the period of greatest malaria transmission. The houses are sprayed once each year for a variable number of years, depending on the results of the annual technical surveys. Usually spraying for about three successive years is sufficient to eliminate malaria transmission and cause the disease to decline to a point nearing eradication. DDT is used for the most part in 5 percent aqueous suspension, mixed from 75 percent water-dispersible powder carried to each village, and applied at a standard rate of 2.0 gms./sq. m. with compressed-air hand-sprayers. DDT is also applied in emulsion, and some dieldrin is being used at rates of 0.25 gm. and

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0.50 gm./sq. m. *A. minimus* is highly susceptible to control by DDT and dieldrin and can rarely be recovered as adults or larvae in sprayed village areas. The homes of over 10,000,000 people have been sprayed, once to several times each since 1950. The peak in the campaign is believed to have been reached in 1956, with more than 7,000,000 population included in this year's spraying program.

Technical surveys are scheduled during the last half of the year, mainly during the wet season when there is an increase in vector abundance and malaria prevalence. Routine procedures include daytime inspections of houses and typical larval habitats for anophelines, dissection of female anophelines for malaria öocysts and sporozoites, spleen examination of children (aged 2–9 years), and blood examination of children (same age group) and infants (aged 1–12 months). The surveys reach at least 20 percent of all operational villages each year, the sample being distributed to reach every canton (administrative group of villages) and those villages selected as likely to represent the most malarious conditions. Over 4,000 villages are reached by the annual surveys, exclusive of special investigations. The results of the routine surveys are analysed, at the close of the survey period each year, with respect to criteria established to judge further control requirements.

Anti-malaria vigilance—a permanent program of protective surveillance and incidental control operations—is instituted on the basis of the following criteria: *A. minimus* not found in adult and larval collections, malaria infection not found in infants, malaria parasite rate less than 1 percent and spleen rate less than 10 percent in children, and adequate protection of the area against resurgence of malaria. On the basis of these criteria the house-spraying campaign has been discontinued and anti-malaria vigilance instituted in areas of over 3,055,000 population. Respraying has been required in less than 10 percent of the areas of protective surveillance, and it is estimated that over 90 percent of all malarious areas in Thailand will be in the vigilance program by 1960. Special features of anti-malaria vigilance are now under development, including the cooperation of hospitals, health centers and other agencies in providing for blood examination of suspected malaria cases.

Malaria treatment supplements the house-spraying campaign as a control measure and is an important feature of anti-malaria vigilance. Large quantities of chloroquine drugs (Aralen and Nivaquine) are supplied to the malaria control field headquarters and other health agencies for treatment of all suspected malaria cases. Atabrine (or Mepacrine) has been distributed widely throughout Thailand, largely in previous anti-malaria programs. Limited quantities of Camoquine and Daraprim have been used in the present project, and Primaquine has been stocked for use in radical cure of *vivax* malaria.

Training activities include advanced study and observation abroad by key medical officers, technical training of laboratory and field assistants, and in-service training of technical aides and local house-spraying squads. Nine of the medical officers have received training at the Malaria Institute of India, followed by training in the United States and elsewhere abroad, and like provisions are being made for others. The technical assistants are trained in Thai Government courses leading toward civil service appointment in the anti-malaria service. The course and facilities were expanded at the Chiengmai Center in 1952 with ICA assistance, and 93 technicians have since received training there. Over 100 technical aides and several thousand foremen and spraymen have had in-service training at the various field headquarters. The Chiengmai Center and a similar institution at Phrabuddhabat are being developed for training and research in vector-borne disease investigation and control. The training activities also

include specially arranged courses for anti-malaria personnel from other countries, especially Laos which is developing its technical staff through a series of training courses in Thailand.

Public information on malaria and its control is disseminated through posters, leaflets, booklets, talks in village centers, home contacts, exhibits at public gatherings, ten field motion picture outfits, and newspaper, magazine and radio features. The field work of the informational program in closely coordinated with the house-spraying campaign and the technical surveys. In addition to the wide-spread informational accomplishments through the above media and activities, the anti-malaria program has carried a practical demonstration of the value of international cooperation directly into the homes of more than half of the national population.

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RESISTANCE OF *CULEX QUINQUEFASCIATUS* TO CHLORINATED HYDROCARBONS ON OKINAWA

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It is known that long and intensive use of chlorinated hydrocarbon insecticides may cause the development of resistant strains of insects. Okinawa, a relatively small island where these insecticides have been used for several years, is a place where such resistance would be expected to develop. DDT was first used on the island during World War II, when it was widely dispersed by airplanes and ground control groups. Extensive application of this insecticide was continued by various organizations after the war. In July, 1947, a permanent insect control program was established on military installations and in an area one mile wide around the perimeter of these units. This program, with necessary changes and improvements, is still in effect. DDT is used as a residual house spray for adult mosquitoes and continues to be the primary insecticide used in larval control. The Government of the Ryukyu Islands undertakes mosquito control measures in all areas not protected by the military program. This agency used DDT from 1947 through 1952, and both DDT and chlordane from 1953 until the present.

The first evidence of resistance sufficient to affect mosquito control on Okinawa was observed by field workers in 1954. Preliminary laboratory tests conducted early in 1955 suggested that the larvae of *Culex quinquefasciatus* had become resistant to DDT and chlordane. The experiments cited below were made during the winter of 1955–1956 to ascertain the degree of resistance of *Culex quinquefasciatus* to

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these insecticides and to dieldrin, lindane and malathion.

METHODS. Late third and early fourth instar larvae were collected for testing from ditches, streams and temporary pools at Awase and Naha in southern Okinawa. The larvae were then held over-night to allow injured specimens, or those that might have had recent exposure to insecticides, to die before testing. Ten larvae were placed in each of three petri dishes, making a total of thirty larvae for each concentration of insecticide. Ten additional larvae were placed in a petri dish with distilled water and used as a control for each concentration. The larvae were held in the insecticide for forty-eight hours, at which time those individuals which had pupated were discarded and all dead and moribund larvae were counted.

The figures shown in Table 1 are averages of three to five replicates. The Reed-Muench method was used to obtain the LD 50s shown in Table 2.

No non-resistant strains were available for comparison, but according to other reported resistance (see references), this species is extremely resistant to DDT and chlordane. There is also considerable resistance to the other chlorinated hydrocarbon insecticides tested.

TABLE 2.—LD 50 estimates of the five insecticides tested against *Culex quinquefasciatus*.

Insecticide	No. of Tests	LD 50 Range in p.p.m.		Geometric LD 50 Mean
DDT	3	.2	.8	.6
Chlordane	3	.9	1.7	1.2
Dieldrin	5	.08	.5	.2
Lindane	3	.08	.5	.2
Malathion	4	.003	.03	.01

SUMMARY. Inability to control *Culex quinquefasciatus* larvae on Okinawa with DDT and chlordane prompted initiation of a series of tests with these insecticides as well as dieldrin, lindane and malathion. Results of these tests indicate that this mosquito is extremely resistant to the chlorinated hydrocarbon insecticides and that it has little or no resistance to malathion.

TABLE 1.—Toxicity of five insecticides to larvae of *Culex quinquefasciatus*.

	Percent Mortality in 48 Hours				
P.P.M.	DDT	Chlordane	Dieldrin	Lindane	Malathion
2.0	96.6	66.4	100	100	100
1.0	59.9	33.7	94.5	97.7	100
.5	48.3	8.8	72.0	83.2	100
.1	0.0	4.4	25.4	26.7	100
.05	0.0	4.4	6.98	8.8	100
.025	....	....	....	....	64.12
.01	....	....	....	....	53.85
.005	....	....	....	....	51.0
.0025	....	....	....	....	35.5
.001	....	....	....	....	0.0

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HABITAT AND MALES OF ALASKAN SNIPE FLY PESTS, (*SYMPHOROMYIA:* RHAGIONIDAE)

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The pest problem caused by *Symphoromyia atripes* Bigot in coastal Central Alaska was pointed out by Travis (1949) and Sailer (1951). Frohne and Williams (1951) claimed that *S. kincaidi* Aldrich is as vicious and abundant in Southeastern Alaska as *atripes* and appears on the wing several weeks earlier. The elusive males of both Alaskan Symphoromyias were vainly sought until 1952 when my son Dick and I swept thirty male *kincaidi* at Thane near Juneau and verified the correct association of the sexes made tentatively by Aldrich (1915).

As a basis for eventual control of immature stages of *S. atripes,* entomologists of the Arctic Health Research Center have carried on a modest but prolonged (1950–55) search for the larval habitat in the limited accessible areas of the Upper Cook Inlet where female *atripes* are common. The present note characterizes, though superficially, two *atripes* breeding habitats which were finally pin-pointed in 1955 by recovery of two newly hatched females in Dove type emergence traps. Several hours of intensive sweeping over one of these breeding areas at the beginning of the emergence period the following summer yielded nine *atripes* males, very likely the first taken in Alaska, and two *kincaidi,* a species not previously reported from Central Alaska.

MALES. Interestingly, these Alaskan male *atripes* do not fit very well Aldrich's description of the lone male type specimen (dating back to Osten Sacken's collections of 1876 in California). Dr. Aldrich noted: "I associate this male with Bigot's species (*atripes*) because there are no indications to the contrary, and both sexes were collected by Osten Sacken at the same place only a few days apart. Strangely enough, nobody since his time appears to have obtained this species of female with any male." Alexander Hubert (personal communication, 1953) found a second presumed *atripes* male while searching American museums for the type specimens of all 22 species recognized by Aldrich. Hubert was perplexed that these *atripes* males should be unlike *kincaidi* males, for (as he wrote) "*atripes* is closely related to *kincaidi,* judging by the females." However, our Alaskan male *atripes* are grey, even less like the jet black *kincaidi* males than is Aldrich's type *atripes* male from California. I shall point out the major differences between Alaskan male *atripes* and Aldrich's description. Since *kincaidi* often occurs with *atripes* it may be helpful, also, to show other workers how to separate the species of males easily.

The mesonotum in the nine Alaskan male *atripes* is striped (vittate) almost as conspicuously as in the female; Aldrich's male is "unstriped, not at all vittate." The abdominal color for both sexes of Alaskan *atripes* is similarly grey pruinose. While Aldrich likewise finds it "cinereous pollinose" in the female, he declares it is *black* in the male.

Kincaidi males may invariably be distinguished from Alaskan *atripes* with the unaided eye by use of the following characters: *kincaidi* are jet black, velvety, much more densely pubescent, and the abdominal pile is mostly yellow; the thorax is unstriped or virtually so; the genitalia are preceded by a conspicuous abdominal constriction; the first antennal segment is less swollen; they average smaller (5.5–6.5 mm. long). *Atripes,* on the contrary, are grey pruinose, less pubescent, and the abdominal pile is blackish; the thorax (mesonotum) bears chocolate-brown vittae; the abdomen tapers evenly to the terminalia (without an abdominal constriction preceding a dilatation of the terminalia);

the first antennal joint is more swollen; they average larger (5.5–8.0 mm. long).

It is considered unwarranted to infer that Dr. Aldrich associated the wrong male with female *atripes,* although he himself suggested this might be the case. From the very first the western American Symphoromyias have given taxonomists trouble. Osten Sacken in 1877, cited by Aldrich (1915), said of the Californian species, of which there are fifteen: "As these species resemble each other very closely, and as both sexes often differ in coloring, I deem it more prudent not to attempt to describe them." Symphoromyias vary intraspecifically, too, e.g., the nine males of *atripes* collected in the same area near Independence Mine August 4, 7, and 8, 1956, range 5.5–8.0 mm. in length. Size varies similarly in *kincaidi.* The genus is practically based on the closed anal cell, and yet I have several *atripes* females with open anal cells, and Alexander Hubert has seen the same condition in *S. sackeni. Atripes* females seem to become darker further south. Thus Southeastern Alaskan specimens generally have a darker stigma and markedly heavier infuscation of the wings than Cook Inlet specimens. It may be especially interesting to secure male *atripes* from the Southeastern region, since these males might be expected to approach or even fit Aldrich's type. A more promising approach, however, is to search out the larvae for rearing in the habitat to be described in the following paragraphs.

BREEDING AREAS. The females of *S. atripes* occur locally along fast coastal streams of Southeastern and Central Alaska from sea level to about 3500 feet. Often they are most numerous and troublesome at about the 2500-foot level where bushy alders, willows, and dwarf birches replace the conifers as the characteristic woody plants. Snowfall is heavy on these slopes or plateaus, and the summer is short and wet. *S. kincaidi* females are found in the same areas as *atripes* in Southeastern Alaska; they have been overlooked in Central and Western Alaska though known now to be present, but rare, since the collection of two *kincaidi* males in the Upper Cook Inlet in 1956.

One has the impression from accumulating collection data that neither species actually breeds in the forest of Western hemlock, Sitka spruce, and Douglas fir (Southeastern Alaska) or in the black or white spruce woods (Central Alaska), but that the females descend to the inhabited forested areas along the streams to seek blood. Certainly conifers are unessential, because *S. atripes* abounds at Kukak Bay, Alaska Peninsula, beyond the westward limit of conifers. At any rate three seasons were spent in a vain search for breeding places in the forests near sea level.

Two similar alpine areas, from each of which one *S. atripes* hatched in an emergence trap, will be described preliminarily as representative *Symphoromyia* breeding habitats. Larvae must, of course, be collected before the specific immature microhabitat, which is undoubtedly in the wet peaty soil, can be designated. The positive breeding places are in the exceedingly craggy watershed of Fishhook Creek. They are one mile and one and three-quarters miles below Independence (gold) Mine, which is in the Talkeetna Mountains about fifteen miles northwest of Palmer, Alaska. They lie between the Willow Creek Road and Fishhook Creek at elevations about 3,200 and 3,000 feet. Fishhook Creek is a permanent mountain torrent, fed by snow fields, which dashes madly through, over, and about granite boulders, rocks, and rubble forming a terrain so helter-skelter that it proved practically impossible to find spots level enough for the Dove type emergence traps. There is, nevertheless, a good deal of boggy, soggy soil; there are also pockets of standing water among the rocks. The weather there is cloudy or rainy most of the summer. Surface water seldom reaches a temperature as warm as 45° F.

Besides the bushes, luxuriant coarse herbaceous plants are as characteristic of these *Symphoromyia* habitats as the rocks and wetness. The tall weeds *Heracleum*

lanatum (wild celery) and *Veratrum eschscholzii* (hellebore), from the flowers of which the snipe flies were probably swept (since the pollen is often seen adhering to their eyes), grow rankly shoulder or even head high. Aside, too, from ubiquitous Alaskan plants such as bunchberry, Labrador tea, broad and narrow-leafed fireweeds, and some uncommon or inconspicuous flowering plants and mosses which were omitted from the following list, the species of characteristic plants listed, probably provide the most practical way to recognize the snipe fly habitat. I am indebted to my wife, Gertrude Frohne, for naming the plants which I have tried to arrange according to conspicuousness and abundance: *Valeriana sitchensis; Geranium erianthum; Aquilegia formosa* (columbine); *Aconitum delphinifolium* (monkshood); *Anemone narcissiflora; Luetkea pectinata; Limnorchis hyperborea* and *dilatata* (bog orchids); *Petasites frigidum* (colt's foot); *Polemonium acutiflorum* (Jacob's ladder); *Senecio triangularis; Myosotis alpestris* (forget-me-not); *Loiseleuria procumbens* (trailing azalea); *Erigeron grandiflorus; Castilleja pallida; Epilobium* spp. (3 small species); *Vaccinium uliginosum* (blueberry); *Ranunculus* spp. (buttercups); *Sedum roseum; Swertia perennis* (star gentian); *Veronica wormskjoldii* (alpine speedwell); *Zygadenus elegans* (death camas); *Saxifraga* spp.; *Leptarrhena pyrifolia* (leatherleaf saxifrage); *Viola langsdorfii, epipsila,* and *selkirkii; Phyllodoce glanduliflora* (yellow heather); *Cassiope stelleriana* (heather).

SUMMARY. Males of the snipe flies, *Symphoromyia atripes* Bigot and *S. kincaidi* Aldrich were swept in two mountain areas where there was evidence of larval breeding in the Upper Cook Inet region, Central Alaska. No *S. atripes* males have been taken heretofore in Alaska. Differences from the type specimen are pointed out. *S. kincaidi* has not been reported previously from north of Southeastern Alaska. The alpine breeding areas of the two Symphoromyias are discussed, and the habitat is characterized preliminarily by the vegetation.

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A NOTE ON THE OCCURRENCE OF *ANOPHELES ALGERIENSIS* THEOBALD IN WESTERN FRANCE

ROBERT A. HEDEEN [1]
Captain, MSC, U.S.A.

Introduction. *Anopheles algeriensis.* Theobald is generally regarded as a species which normally inhabits the Mediterranean Region. However, its sporadic occurrence has been previously reported from central European countries. Marshall (1938) reports its presence from three localities in the British Isles, and Martini (1931) collected adult specimens from Crefeld in Northern Germany. It has also been reported from the following countries which border on the Mediterranean Sea: Italy, Algeria, Greece, Egypt, Libya, Spain, Palestine, Turkey, (Marshall, 1938, and Edwards, 1921). As far as can be determined by the writer, this species has not been reported previously from within the geographical boundaries of France.

The Present Study. This species was collected on two occasions from Western France by members of the U. S. Army Medical Service during the period of 1955 to 1956. In March of 1955 the writer collected four larvae of this species from a semi-permanent pool of water that contained dense vegetation near the city of La Rochelle, in the Department of Charente Maritime. This collection of water also contained large numbers of fully matured larvae of *Aedes rusticus* (Rossi). In April of 1956, the writer was called upon to identify a heterogeneous collection of adult mosquitoes which had been reared from several collections of larvae made the previous month from the vicinity of St. Nazaire in the Department of Loire Inferieure. Sixteen of these adults were readily identified as specimens of *A. algeriensis.* Due to the fact that this collection consisted of adult specimens which were reared from larvae taken from several locations which were undifferentiated by the collector in the immediate vicinity of St. Nazaire, it was impossible to determine the exact ecological niche from which the *algeriensis* specimens were collected. From the information available, however, it is considered quite possible that the specimens of this species were collected from the margins of a slow-moving stream that was slightly brackish in nature.

Russell, *et al.,* (1943) states that specimens of *A. algeriensis* infected with malarial parasites have been found in nature, but that the species is not considered to be an important vector of the disease. Bates (in Boyd, Vol. I, 1949) remarks that the most common breeding place of this species is in spring-fed streams of a constant temperature that does not exceed 20° C. He also states that the adults do not migrate far from their breeding areas, but choose to remain in the immediate vicinity, where they feed mainly on wild animals. For these reasons, Bates considers the species to be relatively unimportant as a vector of malaria in the European and Middle Eastern regions. Edwards (1932) states that in England this species feeds readily on man in the open in calm, dull weather or in sheltered spots at dawn and dusk. Because of these data which have been reported previously, and because of the fact that this species is apparently more widespread in its distribution than was formerly thought, it is the belief of the writer that it may be of more importance than was formerly believed.

Summary. Two records of the collection of *Anopheles algeriensis* Theobald are reported from two different areas in Western France. As far as can be determined, this is the first record of this

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species having been reported from within the geographical boundaries of France. Its sporadic occurrence has been reported from European countries other than France and its importance as a potential vector of disease is briefly considered.

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DISTRIBUTION OF *AEDEOMYIA SQUAMIPENNIS* (DIPTERA, CULICIDAE) IN PANAMA BASED ON LIGHT TRAP SURVEYS

FRANKLIN S. BLANTON [1] AND E. L. PEYTON [2]

The present paper represents the second of a series of small papers on the distribution of Panama mosquitoes based on light trap operations conducted by the 25th Medical Detachment from 1951 to 1953. Although there is only one species of *Aedeomyia* reported from the new world, it is so generally distributed that a small paper giving our records seems indicated. The genus is easily recognized by the pictorial keys of Peyton *et al.* (1955).

This species has been taken in nine of Panama's ten provinces by us and it no doubt occurs in the other province. The Province of Veraguas extends from the Atlantic to the Pacific Ocean including a section of the Continental Divide, a range of rather high hills, bisecting the Province. Very little collecting has been done in this province which no doubt explains our failure to capture a single specimen from Veraguas. Comarca de San Blas is a narrow strip of land on the Atlantic Coast extending from the Colon Province to the Colombian border. This has not been surveyed. This inaccessible area is probably rich in species and no doubt has *Aedeomyia squamipennis*.

The species is very common in some places. It will be noted that 1109 specimens were taken at Tocumen in the Province of Panama from 4–21 December. No disease has ever been attributed to any of the *Aedeomyia*.

The same system for recording the species as described in other papers is used here. Provinces and localities are listed alphabetically and the number of specimens taken at a given time is in parenthesis.

The distribution is as follows:

Aedeomyia squamipennis Lynch Arribalzaga, El Nat. Agr., 6:151, 1878.

Bocas del Toro: Almirante, 16–30 April (15); 1 May, (11); 25 June, (6); 24 Nov., (6).

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[2] Sergeant, First Class, Preventive Medicine Technician, formerly 25th Medical Detachment, Fort Clayton, Canal Zone, now with 6th Army Area Laboratory, Fort Baker, California.

Canal Zone: Gatun Lake (Atlantic Side, 29 Aug., (1); Madden Dam, 28 Apr., (26); 6–27 June (6); 21 Sept., (5); 8 Oct., (3); Mandinga River, 17 Jan., (8); 28 Mar., (16); 25 Apr., (23); 13–15 May (16); Las Cruces, 25 Jan., (1); Loma Boracho, Position 9, 17 July (1); Mojinga Swamp, Station 1, 30 Jan., (2); 21 July (1); 27 Nov., (9); Mojinga Swamp, Station 2, 8 Jan., (3); 7 Feb., (1); 8 Nov., (1); Mojinga Swamp, Station 3, 5 May (2); Mojinga Swamp, Station 4, 15 May (1); 4 Dec., (1).

Chiriqui: Chiriqui, 16 Dec., (1); David, 13–18 Dec., (10); El Volcan, 9 Dec., (1); Gualaca, 14 Dec., (1); Tortugas, 16 Dec., (2).

Cocle: Aguadulce, 7 Aug., (47); 25 Sept., (115); Anton, 11 Nov., (86); Chiru, 10 Nov., (1); El Retiro, 10 Nov., (1); Port Farallon, 8 Nov., (1; Port Obaldia, 11 Nov., (50); Rio Hato, 25 June (6).

Colon: Cativa, 27 Aug., (20).

Darien: El Real, 8 Aug., (2); Garachine, 14 Feb., (2); Patiño Point, 11–29 July (14); 5–19 Aug., (31); 16–17 Sept., (3).

Herrera: Ocu, 4 Mar., (1); Paris, 23 Oct., (62); Pese, 22 Oct., (1).

Los Santos: Guarare, 23 Oct., (1).

Panama: Arraijan, 24 June (2); 2 Aug., (2); 14 Sept., (13); Bayano, 8 Apr., (1); Capitana, 25 Sept., (1); Cerro Campana, 24 Jan., (1); La Jolla, 6–27 Mar., (236); 31 Aug., (22); 7 Sept., (15); 5 Oct., (2); Nueva Gorgana, 16 Sept., (5; Pacora, 27 Jan., (79); 5–17 Feb., (14); Palm Beach, 17 Sept., (1); Rio Las Lajas, 17 Sept., (1); Tocumen, 5–29 Jan., (771); 4–14 Feb., (440); 2–29 Sept., (4); 17 Nov., (29); 4–21 Dec., (1109).

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A COPEPOD PREDACIOUS ON MOSQUITO LARVAE

DAVID D. BONNET and TOMIO MUKAIDA
Division of Sanitation, Department of Health, Territory of Hawaii

The tree hole breeding cannibal mosquito, *Toxorhynchites* (= *Megarhinus*) *brevipalpis* Theobald, from South Africa has recently been introduced into the Territory of Hawaii as an aid in the control of the forest day mosquito, *Aedes albopictus* (Skuse). A laboratory colony has been established and groups of adults and larvae are being released from time to time [1].

During the early developmental stages (1st and 2nd instar), a high mortality occurred which seriously hampered the production of larvae and the development of a flourishing colony. It was believed, at first, that this mortality was the result of improper food duing these early stages and efforts were made to provide various type of microorganisms, including protozoans, rotifers, copepods (nauplii and adults), Cladocera, and 1st instar mosquito larvae of *Aedes* and *Culex* sp. Direct observations were made of food taken by the *Toxorhynchites* larvae and they were observed to ingest protozoans, rotifers, copepod nauplii and the young larvae of other mosquitoes.

It was noted, however, that the presence of adult copepods in the culture jars resulted in a high mortality of the mosquito larvae. The copepods were observed to attack the larvae and kill them in rapid succession. The mosquito larvae would be clasped usually just posterior to the thoracic segment and the body contents sucked out. Subsequently the empty larval skin would be discarded. In a few instances, two or more copepods were seen to attack simultaneously a single mosquito larva of the 3rd and 4th instar and

kill it. The copepod appeared actively to hunt the mosquito larvae, and tests with varying numbers of *Aedes* larvae in 100 cc. of water indicate that a single copepod can destroy from 15 to 20 2nd instar mosquito larvae in a 24-hour period.

The copepod has been identified as the cosmopolitan species, *Mesocyclops obsoletus* (Koch), which has been reported from Norway, Russia, Netherlands, Hungary, Asia, Brazil, Argentina, North America and Australia and is found principally in fresh ponds. It has also reported in brackish water in India [2]. In Hawaii, it has been found commonly in pools, streams and swamps, and undoubtedly destroys young *Culex quinquefasciatus* larvae which occur in such situations. The role played by this copepod in the biological control of *Culex* is not known, but it is probably of minor importance. This copepod has not been found occurring naturally in tree holes, water-holding plants, or other containers in Hawaii and hence would not be a factor in the biological control of our *Aedes* mosquitoes. It has been necessary, however, to eliminate this copepod from our mosquito cultures in order to maintain the colony of *Toxorhynchites brevipalpis* and this note has been prepared to bring the attention of other workers to a copepod which is actively predacious on mosquito larvae in laboratory cultures.

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OPERATIONAL AND SCIENTIFIC NOTES

MALARIA RESEARCH IN EAST AFRICA. In 1954 the East African Malaria Unit became the East African Institute of Malaria and Vector Borne Diseases, and during the past three years the increase of staff that accompanied this change of title has permitted the increasing body of research and other activities that will be briefly summarized in the following account. The Institute works under the administration of the East Africa High Commission and covers the territories of Uganda, Kenya, Tanganyika, Somaliland and Zanzibar. It is assisted by some World Health Organization staff, and by some contributions from the United Nations Children's Fund.

The program of work covers three main lines of activity: research, teaching and consultant advice to the participating territories. The preponderating activities are concerned with malaria, but during the past couple of years an increasing interest is being taken in bilharzia, and other vectors and diseases come into the picture from time to time.

The staff consists of biologists, medical officers, chemists and a malaria engineer, assisted by European field officers, and a variety of junior staff that is wholly African and consists at the higher levels of malaria and laboratory assistants. There is so far one professional African officer.

The first objective of research has been to explore the life history of vector anophelines, and in particular of *Anopheles gambiae*, which plays so predominant a part in the transmission of malaria in tropical Africa.

Bionomics of *A. gambiae* adults. By means of searches in ordinary African huts and specially constructed experimental huts, the gonotrophic cycle in the coastal area of Tanganyika has, among other aspects, been worked out. The duration of this cycle was found to be no more than 48 hours during the greater part of the year, although it could extend to 72 hours when the mean monthly temperature fell below 74° F. for *A. gambiae* and below 78° F. for *funestus*. Although one blood meal normally leads to egg development, this is not the case in virgin females, in which a second blood meal is frequently required before ovarian development is completed, whether fertilisation has taken place or not. The recognition of these *pregravid* females has led to the possibility of separating off a very young age group of female *Anopheles*, and this group has been further sub-divided by use of the discovery that a "mating plug" can be seen in the oviducts of fertilised females, and by the presence or absence of sperms in the spermathecae. The ability to distinguish the very young from the general female population gives an index of anopheline survival.

Although the majority of *gambiae* remain within the house for 24 hours, it has been found that about half leave midway through the gonotrophic cycle, and can thereafter be found out of doors, with difficulty in the coastal area, but to a greater extent in certain inland areas. This tendency to leave the house is much less apparent in the case of *funestus*.

The feeding habits, as determined by precipitin tests, of the two species have also been found to differ widely inland as compared with the coast. Whereas *funestus* is predominantly a human feeder in either case, *gambiae* is to a large extent a cattle feeder in the inland areas. While this difference is to some extent associated with cattle, their presence does not by any means wholly explain the differences found as, even away from cattle concentrations, only 80–90 percent of *gambiae* have fed on man, as compared with 90–100 percent of *funestus*.

Mass catches of mosquitos, in a restricted area of half-mile radius, have shown that the density of vector *Anopheles* in the coastal area is of the order of 10 females per acre, of which only 16–20 were resting outside houses.

Studies on Anopheline Larvae. These studies on the bionomics of adults by Dr. M. T. Gillies, have their complement in experiments on the ecology of anopheline larvae by Mr. M. G. Christie, who has developed reliable methods for the enumeration of larvae, and for the recovery of anopheline eggs, in breeding places. By the use of these methods, it has been shown that *A. gambiae*, which is essentially a rainwater breeder, owes at least some of its great reproductive capacity during wet periods to the absence of predators from temporary water collections. Thus when predators are removed from a more permanent breeding place, larval survival rises from 4 to near 60 percent. A further factor in the population dynamics of this species is indicated by the finding that viable eggs can be found stranded on the edge of a drying pool or puddle, and these will hatch when further rain refills the breeding place.

Pilot Malaria Control Project. To a variable extent these researches on the natural history of East African malaria vectors form a background to a project in malaria control by means of residual spraying with dieldrin, in an area along the eastern Kenya—Tanganyika border. It is in this area that, although malaria is hyperendemic, *gambiae* is less anthropophilic as compared with the Coastal districts. This project, which covers a population of about 50,000, is still in progress. So far *A. funestus* has practically disappeared, and only one infected *gambiae* has been found since the first spraying; human parasite rates have fallen greatly. Extensive observations by Dr. A. Smith on house popula-

tions, biting rates, feeding habits, and outside resting, of *Anopheles* are intended to give a clear picture of what occurs, and an explanation of success or failure in the interruption of transmission. Complementary studies by Dr. C. C. Draper on human malariometry, growth rates in children, haemoglobin levels and so forth are on the other hand designed to give at least a preliminary indication of the effect of malaria on man in such areas, if the attempt to arrest transmission is successful.

Insecticides. An essential part of the residual spraying project is of course the observation of insecticidal activity in huts sprayed. Other insecticidal work has been concerned with the assessment of larvicides, and it has been shown that dieldrin is some ten times as active as DDT against *A. gambiae*. More recently dieldrin in a granulated formulation has been applied by aircraft in field trials at Dar es Salaam, and found to be very effective in wide swampy areas otherwise very difficult to control. All these insecticidal projects are carried out in collaboration with a neighbouring research organization, the Colonial Pesticides Research Unit.

Advice and Teaching. Advice and assistance in assessment are being given to control projects carried out by territorial medical departments, usually with the assistance of the World Health Organization, as in the Highland areas of Kenya, in Somaliland, and Zanzibar. As opportunity presents, surveys of malaria and bilharzia, and of their vectors, are carried out from time to time in the territories, and the amount of such much needed work is limited only by the availability of staff. Similarly advice on methods and materials is given, and schemes prepared. In the case of drainage projects, this is the work of the Malaria Engineer.

Finally the teaching activities of the Institute, mainly for African Health Inspectors and others, but also for Europeans, use up a good deal of the resources of the senior staff. Some 240 Africans and Europeans have so far attended courses lasting three to five weeks. These cover both the theory and practice of mosquito control, and some of the basic knowledge necessary to an understanding of control. Without a great increase in the number of trained assistants, any projects for the extension of vector borne disease control in tropical Africa are meaningless.—D. Bagster Wilson, East African Inst. of Malaria and Vector Borne Diseases.

NOTES ON THE SEASONAL ABUNDANCE OF *Culex tarsalis* COQ. IN TEXAS. Immature stages of the mosquito *Culex tarsalis* Coq. may be collected in Texas throughout the year. In the course of collections made throughout the state in 1954–1955, larvae were abundant from April through June. Larvae became less numerous during the hot summer months. In September and November, another increase in larval population was observed; this was followed by decreasing numbers during the colder winter months. Randolph and O'Neill (1944) report that large numbers of this mosquito can be collected in Texas in early spring and fall.

Larvae and pupae apparently can withstand a wide range of temperatures and water types. Specimens have been collected from water varying in temperature from 105° F. (Hot Springs, Big Bend National Park, Texas; temperature reported by park officials), to water of a temperature of 38° F. which had been frozen over lightly the night before collections were made. Additionally, fourth instar *C. tarsalis* larvae and pupae have been collected from the brackish water of tidal flats at Corpus Christi, Texas.—John M. White, Oklahoma Baptist University, Shawnee, Oklahoma.

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ROLE OF ALBUMINOID AMMONIA AND OTHER FACTORS IN THE BREEDING OF *Anopheles sundaicus* (Rodenwaldt): A PRELIMINARY NOTE (Summary). An unprecedented outbreak of malaria in 1930 in the Budge Budge area about 16 miles south of Calcutta, India, was traced to *Anopheles sundaicus*. Subsequent study of the breeding habits of this mosquito in brackish water swamps and other areas in the vicinity of Calcutta indicated that it could tolerate a wide range of salinity.

The present report summarizes some of the more significant findings of a ten-year study (1935–1945) of the ecological factors which might be critical in the production of *A. sundaicus* in various habitats such as tanks, ponds, lakes, borrow pits, swamps, tidal creeks, and canals. Factors investigated were pH, alkalinity, albuminoid ammonia, free ammonia, absorbed oxygen, dissolved oxygen, nitrites, nitrates, carbonates, iron, calcium, and suspended matter.

A preliminary analysis of data collected before, during, and after breeding of *A. sundaicus* indicates a correlation with albuminoid ammonia content, breeding being observed when the albuminoid ammonia content was low compared to the before and after readings. Most breeding was observed when the albuminoid ammonia was below 0.3 ppm, but some breeding occurred when the content was as high as 0.68 ppm.

No correlation was observed with free ammonia or the various other factors studied. The findings confirmed previous observations as to the wide tolerance of *A. sundaicus* for salinity, positive breeding being observed in situations where the salt content ranged from 160 to 6,800 ppm.—Purnendu Sen, School of Tropical Medicine, Calcutta, India.

EDITORIAL

THE CENTENNIAL OF DR. L. O. HOWARD

HELEN SOLLERS

Plant Pest Control Division, Agricultural Research Service, United States Department of Agriculture

June 11, 1957 is an important date for entomologists, for it is on this day that we celebrate the one hundredth anniversary of the birth of a famous entomologist whose life began at Rockford, Illinois in 1857. Dr. Leland Ossian Howard, Chief of the Bureau of Entomology, United States Department of Agriculture for nearly a quarter of a century, probably did more to promote entomology in the United States than has any other person. Nor did his efforts stop here. Through his numerous trips to foreign countries and because of his world-wide contacts, his impact on entomology in many parts of the world was strongly felt.

Dr. Howard is perhaps best known to mosquito workers as a world authority in medical entomology. He was the first in the United States to report on the use of kerosene to kill mosquito larvae and his experiments led to the universal use of petroleum oil as a mosquito larvicide.

One of his important books, entitled "Mosquitoes—How They Live, How They Carry Disease, How They are Classified, How They May Be Destroyed," which contained the facts that malaria and yellow fever are mosquito-borne, was published at precisely the right moment. At that time (1901) yellow fever was the scourge of Havana and Panama and his recommendations were put into immediate use to help rid both areas of the disease. Later, in collaboration with H. G. Dyar and F. Knab, he embarked on a more ambitious scheme and produced the classic work, "The Mosquitoes of North America, Central America, and the West Indies." The book gave a great impetus to mosquito studies and early control efforts.

He was a prominent supporter of campaigns against disease-carrying insects and the slogan, "swat the fly," became a national one.

Dr. Howard was an intellectual giant who made outstanding contributions in many other fields of entomology. He received numerous medals and awards not only in the United States but also in foreign countries. He was a member of practically every entomological society in the world and took part in many international scientific meetings. The many honorary positions he held are too numerous to mention here.

Among his more than 900 publications, were included such books as "The Insect Menace"; "The House-fly, Disease Carrier"; "A History of Applied Entomology"; "The Insect Book" and "Fighting the Insects: The Story of an Entomologist."

Howard was known for his interest in and kindness to young entomologists and was a great stimulus to them. And now today, one can easily detect the enthusiasm which entomologists feel toward him. In fact, in Washington, D. C., the enthusiasm has reached such proportions that a dinner in his honor was held on June 11, 1957 at the Cosmos Club where he was a prominent figure for many years. Our only regret is that Dr. Howard was not living to participate in the celebration. As his daughter Lucy says, "Father would have enjoyed every minute of it."

ASSOCIATION NEWS

MINUTES OF THE 13TH ANNUAL MEETING OF THE AMERICAN MOSQUITO CONTROL ASSOCIATION HELD AT MIAMI BEACH, FLORIDA, APRIL 28, 29, 30 AND MAY 1, 1957

RECORDED AND REPORTED BY A. F. GEIB, RECORDING SECRETARY

I. THE BUSINESS MEETING OF THE BOARD OF DIRECTORS CONVENED AT 10:00 A.M., DILIDO HOTEL, MIAMI BEACH, FLORIDA, APRIL 28, 1957.

Officers and Board members present were: Fred Stutz, A. W. Lindquist, John M. Hirst, Archie D. Hess, Lester W. Smith, Ted G. Raley, Richard F. Peters, Charles Scheel, Ed Washburn, Don Micks, D. Manley Jobbins, B. Hocking and V. S. Minnich. Those absent were R. E. Dorer, Donald MacCreary, C. M. Gjullin and H. P. S. Gillette. Others present: R. L. Vannote, National Adviser; D. L. Collins, Editor, *Mosquito News;* and Committee Chairmen D. R. Johnson, Helen Sollers and John Mulrennan.

President Stutz called the meeting to order. Dr. Hess moved to accept the minutes of the previous meeting as published in the June 1956 issue of *Mosquito News.* Seconded by Ed Washburn, carried.

President Fred Stutz appointed the following Resolutions Committee: Bob Vannote, Chairman, Charles Scheel, Don Micks and Helen Sollers.

The President submitted his report. Attachment #1.

Past President Richard Peters, Chairman, Nominating Committee, submitted the committee's nominations for officers and regional directors. Mr. Scheel moved acceptance, seconded by Don Micks. Carried. Attachment #2.

Mr. Peters moved the appointment of Don Rees as Regional Representative to fill the unexpired term of Archie Hess. Carried.

Treasurer Lester Smith submitted the financial report of the Association affairs. Moved by Richard Peters that $1000.00 of the Special Publications Fund be transferred to the account of the Treasurer. Seconded by Archie Hess. Carried.

In order to be able to incorporate estimates for *Mosquito News,* it was moved by Bob Vannote that action on Treasurer's report be postponed for coordination with the Editor's report. Seconded by Richard Peters. Carried. The President appointed a special finance committee consisting of Richard Peters, chairman, Bob Vannote and Arthur Lindquist to work with Lester Smith, Don Collins and John Hirst, instructing them to report back to the Board, recommending action on how much should be budgeted for *Mosquito News.*

Later, after report of Editor of *Mosquito News* (Don Collins) was read, both the treasurer's report and the editor's report were accepted. Attachments #3a and b and #4.

Report of Finance Committee: Arthur Lindquist, chairman. Moved by Hirst to accept report, seconded by Washburn. Carried. Attachment #5.

Report on Programs by President-elect Lindquist. Following a discussion it was suggested that efforts be made to send out printed programs in advance of meeting.

Report of Local Arrangement Committee: John Mulrennan, Chairman. Mr. Mulrennan indicated approximately $1500.00 from the Florida Association would be turned over for publication of the Proceedings. Report approved and accepted.

Report of Committee on Sale of Advertising in *Mosquito News:* Francis Creadon, Chairman. Presented for Chairman by Secretary. Moved to approve and accept by Raley, seconded by Vannote. Carried. Attachment #6.

Report of Committee on Publications of *Mosquito News:* Cecil R. Twinn, Chairman. Presented on behalf of Chairman by Fred Stutz. Moved approval and acceptance by Raley, seconded by Lindquist, carried. Attachment #7.

Report of Committee on Good Neighbors: Archie Hess, Chairman. Recommended that both local mosquito control districts and commercial concerns be solicited to sponsor Good Neighbor memberships. Suggested issues of certificates of award to those sponsoring. Reported an increase from 72 to 105 Good Neighbor members during the year, with 8 conversions to regular membership. Resigned chairmanship of committee and turned in $600.00 to Treasurer. Washburn moved acceptance of report and that Hess be highly commended for his work on this committee during the past year, seconded by Hirst; carried.

Report of Business Manager of Miscellaneous Publications: Chris Williamson, Presented by Lester Smith; received and accepted. Attachment #8.

Report of Legislative Committee: John Mulrennan, Chairman. Last year's bill S-2870 requesting federal aid lacked approval by Bureau of Budget, Dept. of Agriculture and Dept. of Health, Education and Welfare and did not get out of committee.

Legislation similar to last year's bill has been submitted for approval of the new Congress. Bill #704 presented by Senator Holland of Florida incorporates the thinking developed at last year's meeting of AMCA at Beaumont, Texas. Additional bills, some similar and others varying somewhat from S-704 have also been submitted to Congress. A few of these are listed:

H.R. #3865, Rogers of Florida
H.R. #4211, Magnuson of Washington
H.R. #4937, Metcalf of Montana
H.R. #4752, Fallon of Maryland
H.R. #4646, Dixon of Utah

The Chairman requested the AMCA to get behind proper and desired legislation and to take a stand one way or another on federal aid for mosquito control. Hirst moved to approve and accept report, seconded by Washburn; carried.

Meeting adjourned at 12:30 p.m. Meeting reconvened at 2:30 p.m. with Sam Minnich and Tommy Mulhern present in addition to those present during earlier session.

Report of Miscellaneous Publications Committee: Commander Hirst, Chairman. Chairman reported on status of Bulletin No. 4. Still in committee with no agreement on contents and editing. Tentative estimates on cost would be $905.00 for first 500 and 15 cents for each additional copy. Moved by Hirst to send letter of thanks and commendation to members of committee and contributors, seconded by Raley; carried. Moved by Washburn that advertising be excluded from Bulletin No. 4, seconded by Dick Peters; carried. Moved by Dick Peters to approve and accept report, seconded by Archie Hess; carried.

Report of Membership Committee: Don Johnson, Chairman. Moved by Lindquist to approve and accept report of committee, seconded by Hirst; carried. Attachment #9.

Report of Historical Committee: Harold Gray, Chairman. Moved by Washburn to accept committee's historical report for publication in *Mosquito News* when completed, seconded by Hess; carried.

Report of Bylaws Committee: Bailey Pepper, Chairman. Presented by Bob Vannote. Moved by Vannote that the proposed bylaws be approved by the Board for subsequent action by Association membership at regular business meeting, seconded by Sam Minnich; carried. Attachment #10. See also under general business session May 1, for comment on a proposed amendment.

Old business—Moved by Lester Smith that Helen Sollers and Helen Louise Durkee be authorized to determine who should be receiving exchange publications and that Helen Sollers be reimbursed, on submission of proper billing to the Association treasurer, for costs of this com-

mittee's activity, seconded by Scheel; carried.

Report of National Adviser: Bob Vannote. Handled 87 pieces of correspondence relating to Association business and activities during the year. Attended as many meetings as possible. Have followed legislative bills. It appears at present there is very little likelihood of passage of any bills during this session of Congress. Encouraging prospect of getting financial aid from the Ford Foundation for publication of *Mosquito News*. Moved by Washburn to approve report of National Adviser, seconded by Hirst; carried.

Report of Executive Secretary: T. G. Raley. Moved by Jobbins that Secretary be authorized to approve membership applications, seconded by Micks; carried. Moved by Brian Hocking, seconded by Dick Peters, that the secretary be instructed to investigate the cost of printing back issues of *Mosquito News* in short supply and report his findings at next board meeting. Carried.

The Secretary was granted permission to approve requests by commercial firms to reprint articles from *Mosquito News*. Moved by Micks to accept the report of the Executive Secretary, seconded by Washburn; carried. The following actions had been approved by mail vote during year: (1) travel allowance for Collins, Creadon, Smith and Raley to attend annual meeting, (2) underwriting cost of publishing Bulletin No. 4 and granting Miscellaneous Publications chairman full editorial prerogatives.

The President appointed a committee, Jobbins, Chairman; members Washburn, Hess, Collins and Foulk to review the possibility of recognizing the lifelong work of W. H. W. Komp in the field of mosquito control by dedicating an issue of *Mosquito News* to him.

Annual meeting for 1958—Following discussion for location of next annual meeting, Hirst moved the meeting be held in the Washington area, seconded by Raley, carried.

Meeting adjourned 5:30 p.m.

II. FIRST GENERAL SESSION, MONDAY, APRIL 29, 1957

Officers and Regional Directors nominations for 1957 were reported to the general membership. No action necessary.

III. GENERAL BUSINESS SESSION, MAY 1, 1957

The meeting was called to order at 8:15 p.m. by President Stutz.

The President entertained a motion for acceptance of the minutes as published in the June, 1956 *Mosquito News*. It was so moved by Archie Hess, seconded by Ed Washburn; carried.

Executive Secretary Raley reported on the affairs and financial status of the Association. Raley moved the acceptance of the Secretary's Report, seconded by Mulhern; carried. See Treasurer's Report.

Report of Standing Committee on Public Relations: Ernestine Thurman, Chairman. Dick Peters moved acceptance of report and that the committee be authorized to proceed with selection of membership pin, seconded by Hirst; carried. Attachment #11.

President Stutz called for nomination of officers. Nominating committee chairman Dick Peters re-read nominations for officers and Regional Directors. Nominations from the floor were called for; there being none, Dick Peters moved acceptance and approval of nominations, seconded by Helen Sollers; carried. See attachment #2 and covers of *Mosquito News*.

President Stutz called for a report from the Bylaws committee. In the absence of Chairman Bailey Pepper, Bob Vannote reviewed in a general way the actions of the committee and the proposed bylaws. Vannote moved acceptance and adoption of the proposed bylaws, seconded by Mulrennan; carried. See attachment #10.

Ken Quarterman offered an amendment to the newly adopted bylaws, which proposed a method of election of officers by mail. It was pointed out, however, that there had not been any time for either

the membership at large or the directors or other committees to study this amendment, and that in the form proposed it appeared to impose an impossible burden on the Secretary and on the budget for mailing expenses. The amendment was not carried, and Mr. Quarterman will submit it to the bylaws committee for further consideration.

Bob Vannote, Chairman of the Resolutions Committee, presented the resolutions and moved their adoption. The resolutions were acted upon separately. No. 1 seconded by Dorer; carried. No. 2 seconded by Peters; carried. No. 3 seconded by Peters; carried. No. 4 seconded by Carmichael; carried. No. 5 seconded by Hess; carried. No. 6 seconded by Mulrennan; carried. No. 7 seconded by Mulrennan; carried. No. 8 seconded by Hirst; carried. Resolutions attachment #12.

The new President, Arthur Lindquist was introduced. He stated that he would carry out the duties and responsibilities of the office to the best of his ability and would look for help from the entire membership. He expects everyone to promote and encourage membership and all other activties of the Association. He expressed his appreciation of the honor of being elected President and extended his thanks to the Association members.

Dr. Bickley announced plans were underway to hold the 1958 annual meeting in the Washington area; probably late February or early March. It will be sponsored by the Central East Region, including North Carolina, Virginia, Maryland, Washington, D. C., and Delaware.

President Lindquist introduced the new officers of the Association and thanked the retiring members for their services.

Meeting adjourned 9:25 p.m.

Board Meeting May 1, 9:30 p.m.

Officers and directors present were: President A. W. Lindquist, J. M. Hirst, Fred Stutz, Dick Peters, Les Smith, Archie Hess, M. Jobbins, W. E. Bickley, Don Micks, V. S. Minnich, Ed Washburn, T. G. Raley, A. F. Geib, B. Hocking and Don Grant. Others present included R. E. Dorer, Bob Vannote, Don Collins, Francis Creadon and J. Mulrennan.

President Lindquist submitted for approval the membership of the various committees for 1957. Stutz moved approval and acceptance of committees, seconded by Jobbins; carried.

Moved by Lester Smith that the President appoint William H. Thom as Assistant Treasurer for 1957, seconded by Dick Peters; carried.

Raley moved that the papers presented at this 13th annual meeting of the Association be published in *Mosquito News*, seconded by Hirst; carried. (Ed. Note: Since the meetings were held so late it was not possible to prepare the Proceedings papers for the current number. Publication of Proceedings papers will begin in September.)

Raley moved that President Lindquist write a letter of commendation for Don Collins and Mrs. Slater to their Director, Dr. Wm. N. Fenton, Asst. Commissioner of Education, N. Y., State Education Bldg., Albany, N. Y., seconded by Jobbins; carried.

Mr. Viesser recommended to the Board that investigation be made and consideration be given to the possibility of selling advertising in the annual program. The program to be widely distributed and well in advance of the meeting. Suggestion to be given consideration and study.

Dick Peters moved that the next annual meeting of the Association be held in Washington, D. C., probably during late February or early March, seconded by Raley; carried.

Meeting adjourned at 11 p.m.

ATTACHMENT #1

Report of President to Board of Directors American Mosquito Control Association, Inc.

April 28, 1957

I wish you to know that I am proud to have had the honor of being your presi-

dent for the past year. I strongly feel that our organization has become mature and that we are a stable and smoothly functioning association, filling a need in the world of scientific mosquito control endeavors. I further feel that we have only started our solid growth and that our efforts will steadily lead to an ever widening circle of influence and respect among scientists, control workers, and the public.

The health and vigor of the AMCA is attested by the interest and work put forth by our various committees and individual members. The continued requests for back issues of *Mosquito News,* both from American and foreign libraries, is an accomplishment we should view with pride.

All organizations have their ups and downs — fortunately our direction has been steadily upwards. Let us continue upwards and if we have our downs, let it be because mosquitoes have been conquered.

I consider that our association is making steady progress and fulfilling a need of mosquito control workers. Lest we become vain, let us pause to consider the opinion of the people we serve. I feel there are numerous signs that the people we serve are not pleased with our progress in the control of mosquitoes. This can be seen in the numerous organizational and political changes made in control organizations, in the special committees formed by state legislative bodies and state funds made available to local control organizations. To me, these and other signs point to dissatisfaction with our slow and erratic progress. Many of us who have been in the work for a long time agree. Some feel like the man at the movie—this is "where we came in"—we have seen the show—oiling, ditching, chemicals. It is true we have added color and sound. These attractions have helped but to keep down catcalls and hisses, we must produce a better program. This can only be produced through continued and expanded research. Scientists have lately broken through the veil of mystery surrounding the detection and alleviation of many of the most obstinate diseases of man, thereby giving life and hope to many. The public is demanding comparable progress from us. At least, we must offer more hope for eradication than we can conscientiously do at this time.

Today our lives are lived in an environment of things and ideas that are the result of research. In most instances the research came first. I feel that we must have bold and aggressive research, both in conception and in magnitude. The hydrogen bomb was not a result of research on firecrackers. If we are to get out of the "mosquito chaser" class, we must catch and annihilate the mosquitoes. This will come. The time necessary is in direct proportion to the amount of effort put forth on research. We must support research to a man.

Further, our association must not let itself become embroiled in the matter of what group or groups will lead us through research into a science of mosquito control beyond the comprehension of present day thinking. Let's back any legislation that has research on our problem for its sincere purpose. Let's think big and act big.

In the meantime, we must continue to lead in the dissemination of knowledge and in the encouragement of sound and economical control work. This the AMCA has done and will continue to do in the foreseeable future through its excellent leadership and the publication of *Mosquito News.*

To many of our members the AMCA means the receipt of the journal and attendance at a scientific session once a year. But to you gathered here, membership means work because you are the officers on whose shoulders the majority of the work falls. I wish to commend you and to thank you.

It has been customary to single out individuals for outstanding work and effort on behalf of our association. This I am going to curtail because the list would be too long. I assure you the work is done

for the association and not for personal glory. If the members of the association could see the lists of change orders from Secretary Raley to Editor Collins and Treasurer Smith, they would certainly be impressed with the amount of work involved and with the accuracy of these officers.

Commander Hirst and his committee, producing Bulletin #4, have worked with great diligence and are to be especially commended.

The Historical Committee will please you with the progress they have made. Mr. Mulhern and Mr. Gray have produced an excellent document. The important Bylaws Committee, under the able leadership of Dr. Bailey B. Pepper, is submitting to the membership a much needed new set of bylaws. I feel that I have been remiss in not mentioning more of the committees and the excellent work they have done, but excellent work is the rule and not the exception in our association.

Before closing, I want to thank the silent and unknown-to-me secretaries of our officers and committeemen who have unquestionably given so freely of their time and talents to carry on the work of our association.

Let's proceed with the work at hand.

Fred H. Stutz

ATTACHMENT #2

Report of the Nominating Committee

The Nominating Committee has been polled and by unanimous agreement recommends the following slate of candidates to the Association membership:

President.....Dr. A. W. Lindquist
President-Elect.Commander John M. Hirst
Vice President.....Dr. Archie D. Hess
Treasurer.....Lester W. Smith
Executive Secretary.....Ted G. Raley

Regional Directors:

Northeast.....D. Manley Jobbins
Central East....Dr. William E. Bickley
North Central.....Charles S. Scheel
Pacific Southwest.....C. Donald Grant
Canada.....Dr. B. Hocking

Respectfully submitted,
Milton H. Buehler
J. Melton Williams
Dr. Richard B. Eads
William J. Buchanan
Dr. Don M. Rees
Robert L. Vannote
Rowland E. Dorer
Dr. Cecil R. Twinn
Dr. Eulogio Bordas
Richard F. Peters, *Chairman*

ATTACHMENT #5

Report of the Finance Committee

Committee members have not met formally but have exchanged views by letters and telephone conversations relative to increasing the financial status of the Association. Other members have also been contacted to obtain ideas on increasing funds especially for publication of *Mosquito News*. Publication costs have been on the increase for several years and are still rising. Outside sources of revenue in the form of grants-in-aid from private or public institutions have been explored to some extent but the prospects at present of such aid are not favorable. Increasing membership and advertising is recommended as a sound means of providing extra funds. At sometime in the near future, serious consideration must be given to increasing membership dues by a small amount. At this writing the financial status of the Association is in a healthy condition but more funds could be utilized effectively. The annual budget prepared by Lester Smith has been examined and the Committee recommends its adoption.

Respectfully submitted,
P. Bruce Brockway, Jr.
Austin W. Morrill, Jr.
Kenneth L. Knight
George E. Powers
William E. Bickley
Lester W. Smith
A. W. Lindquist, *Chairman*

ATTACHMENT #3a

AMERICAN MOSQUITO CONTROL ASSOCIATION, METUCHEN, NEW JERSEY

SUMMARY OF CASH RECEIPTS AND DISBURSEMENTS

TREASURER'S ACCOUNT, YEAR ENDED DECEMBER 31, 1956

Audited by Nathan Lipman, C.P.A.

RECEIPTS:		General Account		Special Publications
Balance on deposit—January 1, 1956		$ 3,785.65		$925.80
Dues and subscriptions	$5,697.35			
Advertising	2,647.21			
Back issues	91.78		$1.50	
Reprints	922.90			
Good Neighbor Club	205.00			
Bulletins	14.00			
Publications—Proceedings	1,589.33			
Contribution	10.00			
Other receipts	23.41	11,200.98		1.50
		$14,986.63		$927.30
DISBURSEMENTS:				
Printing of *Mosquito News*, reprints and mailing charges	$8,879.06			
Office supplies, expenses, etc.	140.15			
Postage	280.00			
Fidelity bond	5.00			
Traveling expense	200.00			
Convention expense (Melody Maids)	100.00			
Transferof funds to C. T. Williamson	62.00			
Examination of Treasurer's records	70.00			
Refund to subscriber	5.00			
Bank charges, etc.	16.83	9,758.04		0
Balance—December 31, 1956 (on deposit—Commonwealth Bank of Metuchen, Metuchen, New Jersey)		$ 5,228.59		$927.30

Since Attachments #3a, 3b and #4 are in tabular form, it was necessary to place them out of order to permit their complete presentation on separate pages.

ATTACHMENT #3b

AMERICAN MOSQUITO CONTROL ASSOCIATION, INC.

Office of the Treasurer
Post Office Box 346, Metuchen, New Jersey

BUDGET ESTIMATE 1957

PRESIDENT:		
Postage and stationery	$ 50.00	$ 50.00
SECRETARY:		
Postage	125.00	
Printing, stationery and forms	100.00	
Insurance bond	5.00	
Telephone, telegrams	10.00	
Other expenses	10.00	
Travel expense, Annual Meetings for all elegible members	500.00	750.00
TREASURER:		
Postage	115.00	
Printing, stationery and forms	75.00	
Telephone, telegrams	10.00	
Annual audit of books	75.00	275.00
EDITOR:		
Postage	25.00	
Printing, stationery and forms	25.00	
Telephone, telegrams	25.00	
Printing *Mosquito News* and Reprints, 4 issues; Includes mailing costs	8500.00	8575.00
ADVERTISING MANAGER:		
Postage	50.00	
Printing, stationery and forms	35.00	
Telephone, telegrams	25.00	
Other expenses	10.00	120.00
LIBRARIAN:		
Postage	50.00	
Stationery	20.00	70.00
BUSINESS MANAGER:		
Postage	50.00	
Stationery	10.00	60.00
OTHER EXPENSE:		
Contingencies	100.00	100.00
TOTAL ESTIMATED BUDGET		$9500.00

ESTIMATED REVENUE, 1957

	Actual 1956	Estimated 1957
Dues and subscriptions	$ 5697.35	$ 6000.00
Advertising	2647.21	2800.00
Reprints	922.90	1000.00
Sale of bulletins and back issues	496.61	
Contributions from individuals and Associations	1415.00	1200.00
Other receipts	23.41	50.00
TOTAL REVENUE	$11202.48	$11350.00

Respectfully submitted,
LESTER W. SMITH, *Treasurer*

ATTACHMENT #4

REPORT OF EDITOR OF *Mosquito News* ON VOLUME 16 (1956)

Issue	No. printed		No. pages		Cost	
	Vol. 15	Vol. 16	Vol. 15	Vol. 16	Vol. 15	Vol. 16
March	1250	1450	84*	68*	$1900.86	$1720.96
June	1250	1450	88	152	1650.79	3006.05
September	1300	1450	72	80	1465.61	1630.99
December	1300	1450	80	92	1709.27	2035.36
Total	5100	5800	324	392	$6726.53	$8393.36
Less-payments for extra pages and immediate publication of one article						73.00
						$8320.36

* Plus Index

	No. pages	
	Vol. 15	Vol. 16
Proceedings Papers	*	115
Articles	163	107
Operational and Scientific Notes	..	11
Editorial	4	1
Association News	32	22
News and Notes	20	20
Reviews and Abstracts	7	11
Bibliography	30	33
Advertising	68	71
Miscellaneous	..	1
	324	392

* No Proceedings papers printed in Vol. 15

Respectfully submitted,
D. L. COLLINS, *Editor*

ATTACHMENT #6

REPORT ON ADVERTISING IN *Mosquito News*

January 1, 1956 to December 31, 1956

The figures below represent transactions during the calendar year 1956 for advertising in four numbers, Volume 15, Number 4 and Volume 16, Numbers 1, 2 and 3. (December 1955 and March, June and September 1956.)

Number of active accounts	26
Number of pages of advertising (exclusive of AMCA business)	68½
Receipts	$2701.21
Expenses:	
Postage, telephone, telegrams	53.50
Printing, rate sheets, envelopes	29.20
Honorarium for stenographer	10.00
Total expenses	$92.70

Respectfully submitted,
FRANCIS P. CREADON
Advertising Manager

ATTACHMENT #7

REPORT OF THE STANDING COMMITTEE ON PUBLICATION OF *Mosquito News*

During the past year your committee has had no problems referred to them relating to *Mosquito News*. The comments, suggestions, and recommendations included in the committee's report submitted at the

Beaumont, Texas, meeting (*Mosquito News* 16:163–164) are still appropriate and are reaffirmed. Dr. Don Collins has continued to do an excellent job as Editor, and he, the associate editors and other members of the staff deserve great credit and the gratitude of the Association for their valuable and unselfish work. It is recommended to the Board of Directors that Dr. Collins be reappointed as Editor for a further term.

Having completed 35 years service in the Entomology Division, I plan to take advantage of the provision for voluntary retirement at age 60 and to leave the Canadian Government Service at the end of this year. Accordingly, although I shall retain my membership in the Association, I wish to tender my resignation as chairman of this committee.*

Respectfully submitted,
C. R. TWINN, *Chairman*
Publication Committee

*Dr. Twinn was persuaded to withdraw his resignation and was reappointed.

ATTACHMENT #8

REPORT OF BUSINESS MANAGER OF MISCELLANEOUS PUBLICATIONS FOR 1956
(C. T. WILLIAMSON)

FINANCIAL STATEMENT
December 31, 1956

CHECKING ACCOUNT	
Balance as of January 1, 1956	$1,057.81
Total deposits for the year 1956	+ 290.50
	$1,348.31
Total expenditures for the year 1956	— 40.50
	$1,307.81

STATEMENT OF SALES
December 31, 1956

Bulletin	Number of Books Sold	Accounts Paid	Accounts Outstanding
1 & 2	1455	$2,896.00	$26.00
3	630	1,216.00	34.00

ATTACHMENT #9

REPORT OF COMMITTEE ON MEMBERSHIP

During the period February 25, 1956 to April 15, 1957 the following membership and subscription gains and losses were made and sustained:

New members	133
Cancellations	—106
Total membership gain	27
New subscriptions	96
Cancellations	—78
	18
Total gain memberships and subscriptions	45

The total membership and subscriptions of the Association is now approximately 1300, based upon the number of copies of *Mosquito News* being distributed.

Every member is urged to obtain new members during the coming year. The membership blanks are to be revised and copies will be furnished to all persons or organizations receiving *Mosquito News* as soon as available. Additional copies can be obtained by writing to the Executive Secretary or the Chairman of the Membership Committee.

Respectfully submitted,
DONALD R. JOHNSON, *Chairman*

ATTACHMENT #10

BYLAWS OF THE AMERICAN MOSQUITO CONTROL ASSOCIATION

Article I. Name and Principal Office

Section 1. Name.—The name of this Association shall be the American Mosquito Control Association (hereafter in these bylaws shall be referred to as the Association).

Section 2. Principal Office.—The principal office of the Association shall be in the Town of Metuchen, New Jersey, or at such other place as the Board of Directors may designate.

Article II. Purpose and Policy

Section 1. Purpose.—(Stated in the Certificate of Incorporation, *Mosquito News*, Vol. 8, No. 4, December 1948, p. 191.) The purpose of the Association is to promote research on and control of mosqui-

toes and related subjects in the broadest sense and to disseminate knowledge of mosquitoes and related subjects throughout the world.

Article III. Membership and Dues

Section 1. Classes of Membership.—Classes of membership shall be:

a. Member.—Anyone concerned with or interested in mosquito control and related work, and desiring to participate in the promotion and improvement of such work, may become a member of the Association upon application endorsed by two members in good standing, and election by a majority of the Board of Directors.

Members shall pay annual dues of $5.00; shall receive *Mosquito News;* and shall be entitled to hold office, serve as delegates to conventions, and to propose motions and participate in discussion.

b. Life Member.—Any member may become a life member of the Association upon payment to the Treasurer of $100.00 in a lump sum, and thereafter shall be exempt from further payment of dues.

Life members shall receive *Mosquito News,* enjoy the same privileges, and carry the same responsibilities as members of the Association.

c. Honorary Member.—A person who has rendered exceptionally distinguished service in the various fields of mosquito control and related work may be accorded special recognition by election to honorary membership in the Association.

Nomination of a candidate for this honor must:

(1) Be in writing.

(2) Bear the signature of ten members in good standing.

(3) Be addressed to the Board of Directors.

(4) Be endorsed by three-fourths of the Board of Directors before presentation at a national meeting of the Association.

(5) Receive three-quarters of the votes cast by the members present and voting at an annual meeting of the Association.

Honorary members pay no dues; receive *Mosquito News;* and are entitled to all of the privileges enjoyed by members.

Section 2. Dues and the Fiscal Year.

a. The Fiscal Year.—The fiscal year shall be from January 1 to December 31.

b. Payment of Dues.—Dues of members are payable on January 1. On June 1, any unpaid dues shall be declared in arrears, and the delinquent members shall be *not in good standing.*

c. Dues of New Members.—Dues of new members received by the Treasurer on or after October 1 shall be credited to the fiscal year beginning on the following January 1, and the new member shall receive the December number of *Mosquito News.*

New members paying dues prior to October 1 shall be counted members for the current year, and shall receive all back numbers of *Mosquito News* for the current year.

Section 3. Resignations.

a. Written Resignations.—A member may resign from membership only when in good standing. A resignation shall be presented to the Treasurer in writing.

b. Reinstatement.—A member who resigns after June 1 shall be liable for dues for the current year. A member who does not resign and whose dues remain unpaid for one fiscal year shall be dropped from membership.

Article IV. Regional Subdivisions

Section 1. Regions.—There shall be ten recognized regions in the territory of the American Mosquito Control Association as follows: (a) Canada, (b) North Atlantic, (c) South Atlantic, (d) Northeast Central, (e) Southeast Central, (f) Northwest Central, (g) Southwest Central, (h) North Pacific, (i) South Pacific, and (j) Mexico, Central and South America. Other regions may be added or present regions may be redefined as the need demands upon approval of the Board of Directors and of the membership.

Section 2. Regional Directors.—There shall be a regional representative or re-

gional director elected from each region to the Board of Directors of the Association. It shall be the duty of the director of each region to promote interest in the Association and to assist individuals, groups and affiliated agencies in the region with matters pertaining to the Association and with local problems concerning mosquitoes and related pests.

Article V. Officers of the Association

Section 1. The Board of Directors.

a. Members of the Board.—The Board of Directors shall consist of one Regional Director from each of the ten (10) regions of the Association and eight (8) Directors at large who shall be:

(1) The Chairman of the Board and President of the Association.

(2) The President-Elect, who normally ascends to the office of President at the next election.

(3) The Vice President of the Board and Vice President of the Association.

(4) The Treasurer of the Association.

(5) The Executive Secretary of the Association.

(6) The Recording Secretary of the Association.

(7)–(8) The retiring President of the Association and his immediate predecessor.

b. Terms of Office.—The terms for which the officers named shall be elected are:

(1) The President of the Board and President of the Association, a one-year term.

(2) The President-Elect, a one-year term.

(3) The Vice President of the Board and Vice President of the Association a one-year term.

(4) The Treasurer of the Association, a two-year term.

(5) The Executive Secretary of the Association, a two-year term.

(6) The Recording Secretary of the Association, a two-year term.

(7) The ten Regional Directors, each a two-year term, five of the ten to be elected each year.

c. Vacancies.—In case of a vacancy in the office of President and/or President-Elect the next officer in line would ascend to the office so vacated. Vacancy of any other office or Regional Director shall be filled by appointment by action of the Board.

Article VI. Powers and Duties of Officers

Section 1. President.—The President of the Association shall be chairman of the Board of Directors, and shall have the usual responsibilities and powers of supervision and management, such as pertains to his office, and such other powers as are specified in the bylaws or properly assigned from time to time by the Board of Directors. He shall have the following specific powers and duties:

a. Shall preside at all meetings of the Association.

b. Shall be ex-officio member of all committees of the Association except the nominating committee.

c. Shall present questions of policy for consideration by the Board of Directors.

d. Shall advise and instruct the secretaries of the Association.

e. Shall execute with the Executive Secretary of the corporation, all legal documents of the Association.

f. Shall name members of standing and special committees with consent and approval of the Board of Directors.

g. Shall call special meetings of the Association; initiate special action by correspondence or other means; name representatives to act in the name of the Association with instructions when there is such need; and to perform other such duties normally expected of him.

Section 2. President-Elect.—The President-Elect shall act in the absence of the President and shall assist the President whenever requested. He shall announce standing and special committees upon taking office as President.

Section 3. Vice President.—The Vice President shall assist the President and the President-Elect with the duties of these offices as directed.

Section 4. Executive Secretary.—The Executive Secretary of the Association shall have the following duties:

a. As Executive Secretary, he shall be responsible for setting in motion and following through with any actions approved by the Board of Directors for:

1. Current activities.
2. For further development of the Association, and
3. For coordinating the objectives, policies, responsibilities, and services of the Association.

b. As Secretary of the Association, he shall:

1. Prepare and keep up to date a membership roster, including such pertinent information about members as directed by the Board of Directors.
2. Quarterly, in advance of the mailing date, advise the publisher of *Mosquito News* of any new names that should be added to, and of any names that should be dropped from the mailing list, or confirm the mailing list of the previous quarter if no changes are to be made.
3. To provide the Treasurer with an up to date membership list and a subscription list to *Mosquito News*.

c. As Secretary of the Corporation, he shall have custody of the Corporation Seal and Records, and shall execute with the chairman of the Board all legal documents of the Association and affix the seal thereto, and in this capacity shall use the title Secretary of the Corporation.

Section 5. Recording Secretary.—The Recording Secretary shall be responsible for the keeping of the minutes of the Association and Board of Directors when assembled in general meeting and of such other meetings as may be held. He shall be responsible for keeping in order, and for compiling from time to time for information of the membership through publication in *Mosquito News,* reports of proceedings derived from such meetings and from proceedings of the Board of Directors as carried on by correspondence.

Section 6. Treasurer.—The Treasurer shall perform the duties usually pertaining to that office, which shall include the following:

a. Collect and record all dues, and any other moneys due the Association; and shall make disbursements as directed by the Board of Directors.

b. Serve as custodian of title deeds, business papers, bonds and other securities belonging to the Association.

c. For the collection of dues, he shall bill each member for current and unpaid dues and any other charges due the Association, at least one month before January 1.

d. To reach members at least one month before the "delinquency" date, June 1, he shall send a "second notice" statement of still unpaid dues, quoting the bylaws to the effect that if dues are not paid by June 1, the member becomes automatically "not in good standing" and no longer eligible for membership privileges.

e. Shall engage a certified public accountant to audit the books annually.

f. Shall submit to the Board of Directors annually a financial statement for the current year together with the report of the auditor.

g. Together with the Finance Committee, he shall prepare budget estimates for the next fiscal year for consideration by the Board.

h. Shall be bonded by a recognized company.

Section 7. Board of Directors.—The Board of Directors shall have the general power to administer the affairs of the Association and to carry out its program and policies and shall act for the Association between annual meetings. It shall have the following specific powers, responsibilities and duties:

a. Adopt rules to govern its own proceedings.

b. Supervise the financial administration of the Association.

c. Establish an annual budget for the Association.

d. Confirm standing and special committee appointments made by the President.

e. Prescribe policies governing the activities and functions of the Association and the regions.

f. Determine the place and date of annual and special meetings and notify the membership thereof.

g. Report its actions and decisions to the membership at each regular business meeting for ratification or approval and publish annually in *Mosquito News* these reports.

h. A quorum of the Board of Directors shall be a simple majority of the membership thereof.

Article VII. Nomination of Officers

Section 1. Duties of the Nominating Committee.—The nominating committee shall submit at the next annual meeting a report on nominations to the membership of the Association at a preliminary business meeting and shall submit at least one nomination for each office to be filled by election at that annual meeting.

Section 2. Other Nominations.—Additional nominations may be made from the floor following the report of the nominating committee. Nominations from the floor must be submitted in writing, giving the qualifications of the candidate. All nominations shall carry the consent of the nominee and assurance that he or they will serve if elected.

Article VIII. Annual Meetings and Election of Officers

Section 1. Annual Meetings.—The Association shall hold an annual meeting, the place and date of which shall be determined by the Board of Directors and announced through *Mosquito News,* or such medium as the Board may decide, not less than eight months before the date set for said meeting. The annual meeting shall be open to all members of the Association. However, only members in good standing shall be eligible to participate in the proceedings.

Section 2. Election of Officers.—All elective officers of the Association shall be chosen by a majority of votes cast at the regular business session of the Association. Unless the candidates for offices to be filled by election at an annual meeting are unanimously accepted either together or singly by the membership as presented by the nominating committee the election shall be by ballot. Balloting, if employed, shall be at the regular business session. If occasion should require, an appropriate method of balloting by mail may be employed in the election of officers.

Section 3. Quorum.—The quorum at the regular business session shall be 25 members, as defined in Section 2 of this article, and representing not less than ten states.

Article IX. Publications

Section 1. Publications.—The Association shall publish *Mosquito News* as the official publication of the Association. *Mosquito News* shall be published quarterly or more often as the Board of Directors may authorize. The Association may publish from time to time, as public interest and need may warrant, special bulletins and other publications.

Section 2. Editor and Staff.—The standing committee on publications shall appoint the editor and other members of his staff with the approval of the Board of Directors.

Article X. Parliamentary Authority

Section 1. Parliamentary Authority.—The rules outlined in Robert's "Parliamentary Law" and Robert's "Rules of Order, Revised," shall govern Association procedure in all instances where they are applicable and in which they are not inconsistent with these bylaws.

Article XI. Amendments to the Bylaws

Section 1. Amendments to the Bylaws.—These bylaws may be amended at any annual meeting of the Association by a two-thirds vote of members present. All proposals for amendment shall be submitted in writing to the Executive Secretary or to the standing committee on bylaws at least four months before the date of the annual meeting. The report of the committee on bylaws shall be sent to the members of the Board of Directors one month

before the annual meeting. These bylaws may also be amended at any regular business session of the Association without previous notice by three-fourths majority of the membership.

ATTACHMENT #11

To: President and Board of Directors of American Mosquito Control Association.

From: Standing Committee on Public Relations, AMCA.

Subject: Annual Report.

Activities have been in direct ratio to the time element for which we offer apologies.

The current meeting was published in *Mosquito News* with announcements on the front and back covers, page-fillers, a program outline, and a center-page spread. Brief announcements were submitted to the editors of: the American Journal of Public Health; the Bulletin, the Journal, and the Annals published by the Entomological Society of America; and the Proceedings of the Entomological Society of Washington.

Interest has been revived in the subject of selecting an official seal and a membership pin for AMCA. Some reasons for having an emblem and pin are:

1. An official emblem of AMCA.
2. Added prestige for AMCA (letterheads, etc.).
3. Identification as member of AMCA.
4. Create public interest in mosquito control.
5. Create interest in AMCA by having a contest for designs.
6. Conversational item.
7. Attractive piece of jewelry.

Recommendations are:

Designs to be considered:

(1) "Parva Culex" pin designed by Mrs. Chenoweth in 1930. The original die is reported to be available at Balfour Company, Attleboro, Mass.

(2) Design by Dorer. By vote of the committee, this design was accepted in 1956. Prices quoted by Balfour Company for reproducing this pin were:

Die and tool charges—$65.00.

Pin with screw post or safety catch:

Sterling silver—60¢ each; 1/10—10 K gold plate —$1.00 each; 10 K solid gold—$3.15 each.

(3) Designs submitted through a contest among AMCA members. Announce a contest in *Mosquito News*. Three most suitable designs selected by the committee. Final selection by the Board of Directors. Publish the accepted design in *Mosquito News*. Award a solid gold pin to the winning designer. Canvass the membership for purchase of pins. Place an order for pins through the committee.

We should like to express our appreciation to Dr. Donald L. Collins, Editor, for the publicity in the *Mosquito News* and for his assistance; and to the editors of the journals in which announcements of the AMCA meeting were published.

Respectfully submitted,

MR. GEORGE POWERS, JR.
DR. JOHN PORTER
DR. RICHARD EADS
MR. ROWLAND DORER
MR. ROBERT PETERS
MR. DONALD JOHNSON
MR. FRANCIS CREADON
MR. ROBERT VANNOTE
MRS. ERNESTINE THURMAN, *Chairman*

ATTACHMENT #12

REPORT

RESOLUTIONS COMMITTEE

During the past year the American Mosquito Control Association has suffered the loss of several of its active members and co-workers through their untimely passing to the great beyond.

THEREFORE BE IT RESOLVED: That we record our great sorrow over this loss and our appreciation for the many years they were spared for devoted service to our Association and their field of public service.

BE IT RESOLVED: That we express our appreciation to management and personnel of the diLido Hotel for their cooperation in extending their facilities for this convention and making our visit so enjoyable.

BE IT RESOLVED: That the American Mosquito Control Association express its appreciation to the officers and members of the Florida Anti-Mosquito Association for sponsoring this joint meeting so successfully completed.

BE IT RESOLVED: That the American Mosquito Control Association recognize the contributions of the late William H. W. Komp in the field of mosquito taxonomy and control, and

BE IT FURTHER RESOLVED: That the Executive Committee be authorized to dedicate suitable space in *Mosquito News* relating to his outstanding accomplishment or to employ such other means as may be appropriate.

BE IT RESOLVED: That the membership of the American Mosquito Control Association record their appreciation to their officers and to those individuals, such as the Advertising Manager of *Mosquito News,* for their sacrifice of time and expense in making the year completed so successful.

WHEREAS: Mosquito control as practiced by some 38 states, territories and Federal agencies is dependent upon adequate and continuous research, and

WHEREAS: The leadership in fundamental research in mosquito control has been, to a large extent, a Federal responsibility for some 50 years with several of the States providing supplemental facilities in the more practical aspects of the problem, and

WHEREAS: The requirements of the States have advanced far beyond the current Federal facility to provide.

NOW THEREFORE BE IT RESOLVED: That the American Mosquito Control Association, in convention assembled, endorse the principle of expanded Federal research, both fundamental and applied, in the field of mosquito control by the several Departments now authorized to provide such services by the expansion of their present facilities and through the utilization of such State or regional research facilities as may be available, and

BE IT FURTHER RESOLVED: That the American Mosquito Control Association urge its membership, as individuals, to take such action as they believe will best accomplish this objective.

WHEREAS: Resistance to insecticides has developed among various insects of public health importance thereby creating a serious hazard to the future control of all arthropod borne diseases and jeopardizing the attainment of malaria eradication in the world, and

WHEREAS: A worldwide survey made by the World Health Organization has ascertained that laboratory and field studies are inadequate to cope with all facets of the problem, which principally requires studies of (1) factors, including ecology, which influence rapid development of resistance, (2) the mode of action of insecticides and, (3) methods of preventing the development of resistance.

NOW THEREFORE BE IT RESOLVED: That the AMCA commend the World Health Organization for the leadership it has provided in defining this problem, and

BE IT FURTHER RESOLVED: That the Association encourage and support the World Health Organization in its efforts to stimulate and coordinate in the laboratory and in the field worldwide research in mosquito resistance to insecticides.

WHEREAS: This meeting of the American Mosquito Control Association at Miami Beach, Florida, on April 28–May 2, 1957, is the twenty-first general meeting of this Association and its predecessor society, the Eastern Association of Mosquito Control Workers, and

WHEREAS: The holding of this twenty-first general meeting signifies the "coming of age" of this organization, and

WHEREAS: This Association and its journal, *Mosquito News,* has earned the respect, cooperation, and participation of mosquito workers and other scientific workers throughout the world, now therefore

BE IT RESOLVED THAT WE, the membership, do hereby express our appreciation to all who have cooperated in carrying out the objectives of the Association, and

BE IT FURTHER RESOLVED: That we rededicate ourselves to the lofty purpose of providing more scientific and more complete mosquito control services to peoples everywhere, through the extension of research, development, education, and application of proved mosquito control practices.

AMERICAN MOSQUITO CONTROL ASSOCIATION, INC.

DIRECTORS, OFFICERS AND COMMITTEES FOR 1957

Editorial Staff of *Mosquito News*—See inside front cover

Board of Directors and Officers—See back cover

Standing Committee on Publication of *Mosquito News:* C. R. Twinn, Chairman, Head, Veterinary and Medical Entomology Unit, Division of Entomology, Department of Agriculture, Ottawa, Ontario, Canada; W. E. Bickley, Department of Entomology, University of Maryland, College Park, Maryland; Don M. Rees, Division of Biological Sciences, University of Utah, Salt Lake City, Utah; Kenneth L. Knight, Division of Preventive Medicine, Bureau of Medicine and Surgery, Department of the Navy, Washington, D. C.; P. Bruce Brockway, Toledo Area Sanitary District, 5015 Stickney Ave., Toledo, Ohio.

Standing Committee on Legislation: John A. Mulrennan, Chairman, State Board of Health, Box 210, Jacksonville, Florida; Arthur F. Geib, Manager, Kern Mosquito Abatement District, 1418 42nd Street, Bakersfield, California; George S. Langford, Department of Entomology, University of Maryland, College Park, Maryland; Doyle Reed, Office of Chief of Engineers, Entomology Section, Building T-7, Gravelly Point, Maryland; Robert Vannote, 3 Franklin Place, Morris Plains, New Jersey.

Standing Committee on Research and Development: W. C. McDuffie, Chairman, USDA, Entomology Research Division, Plant Industry Station, Beltsville, Maryland; Kenneth D. Quarterman, U. S. Public Health Service, Communicable Disease Center, P. O. Box 769, Savannah, Georgia; Colonel Ralph W. Bunn, Forest Glen Section, Walter Reed Army Medical Center, Washington 12, D. C.; Richard F. Peters, State Department of Public Health, 2151 Berkeley Way, Berkeley 4, California; D. Manley Jobbins, New Jersey Agricultural Experiment Station, New Brunswick, New Jersey; Maurice W. Provost, P. O. Box 308, Vero Beach, Florida; William R. Horsfall, University of Illinois, Urbana, Illinois; Lt. Commander Kenneth Knight, Division of Preventive Medicine, Bureau of Medicine and Surgery, Department of the Navy, Washington, D. C.; Eugene J. Gerberg, Insect Control and Research, Inc., Johnnycake Road, Baltimore 7, Maryland.

Standing Committee on Finance: Charles F. Scheel, Chairman, 733 So. Waiola Avenue, La Grange, Illinois; P. Bruce Brockway, Jr., Toledo Area Sanitary District, 5015 Stickney Avenue, Toledo 12, Ohio; G. W. Eddy, USDA, Entomology Research Division, P. O. Box 332, Corvallis, Oregon; Robert L. Armstrong, Carlisle Road, Westford, Massachusetts; Dan F. Boyd, Curtis Automotive Devices, Inc., 8800 N. 15th Street, Tampa, Florida; F. Ray Barron, Jr., American Cyanamid Company, 30 Rockefeller Plaza, New York 20, New York; Lester W. Smith, Ex officio, Middlesex County Mosquito Extermination Comm., Parsonage Road, Metuchen, New Jersey.

Standing Committee on Sales of Advertising Space: Francis P. Creadon, Chairman, 194 Addison Road, Riverside, Illinois; J. Everett Bussart, Velsicol Corporation, 215 W. Harrison Street, Wheaton, Illinois; Robert J. Geary, Geary Research Laboratory, Blue Point, L. I., New York; Oscar V. Lopp, South Cook County Mosquito Abatement District, P. O. Box 338, Posen, Illinois; George L. Hutton, Engineering and Technical Services Division, Bureau of Yards and Docks, Department of the Navy, Washington 25, D. C.

Standing Committee on Bylaws: Bailey B. Pepper, Chairman, New Jersey Mosquito Extermination Assn., New Brunswick, New Jersey; Doyle Reed, Office of Chief of Engineers, Entomology Section, Building T-7, Gravelly Point, Maryland; Charles F. Scheel, 733 South Waiola, La Grange, Illinois; R. E. Dorer, 5709 Sellger Drive, Norfolk 2, Virginia; T. G. Raley, P. O. Box 278, Selma, California; K. B. Quarterman, U. S. Public Health Service, Box 769, Savannah, Georgia; Robert Vannote, 3 Franklin Place, Morris Plains, New Jersey.

Standing Committee on Public Relations: William J. Buchanan, Chairman, South Cook Mosquito Abatement District, P. O. Box 338, Posen, Illinois; Don W. Micks, Laboratory of Medical Entomology, University of Texas Medical Branch, Galveston, Texas; Robert E. Hamman, 1700 K Street, N.W., Suite 1103, Washington 6, D. C.; Harry D. Pratt, U. S. Public Health Service, Communicable Disease Center, 50 Seventh Street, Atlanta, Georgia; Robert H. Peters, No. San Joaquin Mosquito Abatement District, 404 W. Pine Street, Lodi, California; Francis P. Creadon, 194 Addison Road, Riverside, Illinois; E. J. Beidler, Director, Indian River Mosquito Control District, P. O. Box 696, Vero Beach, Florida; H. H. Stage, 2235 N. E. 121st Avenue, Portland 20, Oregon; Ernestine Thurman, Department of Entomology, University of Maryland, College Park, Maryland.

Good Neighbor Club Committee: Ernestine Thurman, Chairman, Department of Entomology, University of Maryland, College Park, Maryland; Robert L. Vannote, 3 Franklin Place, Morris Plains, New Jersey; Helen Sollers, Plant Pest Control Branch, A.R.S., Washington 25, D. C.; Rowland E. Dorer, Virginia State Dept. of Public Health, 301 Essex Building, Norfolk 10, Virginia; Gordon E. Smith, Division of Health and Safety, Tennessee Valley Authority, Wilson Dam, Alabama; William J. Buchanan, South Cook Mosquito Abatement District, P. O. Box 338, Posen Illinois; Albert W. Buzicky, 1709 Rome Avenue, St. Paul 5, Minnesota; C. Donald Grant, San Mateo Co. MAD, 865 Sherman Avenue, Menlo Park, California; Leslie D. Beadle, 50 Seventh Street, N.E., Atlanta 5, Georgia; Archie D. Hess, U. S. Public Health Service, P. O. Box 334, Logan, Utah; Carroll N. Smith, USDA, Entomology Research Division, P. O. Box 3391, Orlando, Florida.

Historical Committee: Harold F. Gray, Chairman, Woodleaf Star Route, Box 3081, Oroville, California; R. D. Glasgow, 1013 Washington Avenue, Albany 3, New York; Thomas D. Mulhern, 5545 E. Shields Avenue, Fresno 3, California; George Bradley, U. S. Public Health Service, Room 5126, HEW Bldg., South, Washington 25, D. C.

Standing Committee on Membership: Donald R. Johnson, Chairman, 2724 Bradley Circle, Falls Church, Virginia, and Regional Directors.

Standing Committee on Miscellaneous Publications: Lt. Commander John M. Hirst, Chairman, Insect Vector Control, U. S. Naval Air Station, Alameda, California; B. V. Travis, Cornell University, Ithaca, New York; A. W. Lindquist, USDA, Entomology Research Division, Plant Industry Station, Beltsville, Maryland; Carroll N. Smith, USDA, Entomology Research Division, P. O. Box 3391, Orlando, Florida; Archie D. Hess, Logan Field Station, P. O. Box 334, Logan, Utah; Vernon Conant, Bergen County Mosquito Extermination Comm., Hackensack, New Jersey; P. Bruce Brockway, Jr., Toledo Area Sanitary District, 5015 Stickney Avenue, Toledo, Ohio; M. H. Buehler, Mosquito Control Officer, Eugene, Oregon; Mrs. A. T. Candy, P. O. Box 511, Glen Ellyn, Illinois; William M. Cox, Mosquito Control Program, Galveston, Texas; John A. Mulrennan, P. O. Box 210, Jacksonville, Florida; Thomas D. Mulhern, 5545 E. Shields Avenue, Fresno, California; L. F. Wells, Mosquito Control

Program, Greenbush, Massachusetts; L. W. Zeigler, Mosquito Control Division, Rockville Centre, New York; R. W. Gies, Delaware County Mosquito Extermination Comm., Media, Pennsylvania; Don M. Rees, University of Utah, Salt Lake City, Utah; C. T. Williamson, 16 Orowoc Avenue, Islip, New York; Hugo Jamnback, New York State Science Service, State Education Building, Albany 1, New York; Leslie D. Beadle, 50 Seventh Street, N.E., Atlanta 5, Georgia.

Committee on Sale of Miscellaneous Publications: Jay E. Graham, Chairman, 1531 E. 4160 South, Salt Lake City, Utah; B. Hocking, University of Alberta, Edmonton, Alberta, Canada; Franklin C. Wray, Desplaines Valley Mosquito Abatement District, 8130 Ogden Avenue, Lyons, Illinois; Thomas D. Mulhern, 5545 E. Shields Avenue, Fresno 3, California; Osmond P. Breland, University of Texas, Austin, Texas; C. T. Williamson, 16 Orowoc Drive, Islip, New York.

Nominating Committee: Fred H. Stutz, Chairman, 118 Northwest First Avenue, Miami 32, Florida—**South Atlantic**; Allen S. West, Department of Biology, Queen's University, Kingston, Ontario, Canada—**Canada**; Robert L. Armstrong, Carlisle Road, Westford, Massachusetts—**North Atlantic**; P. B. Brockway, Jr., Toledo Area Sanitary District, 5015 Stickney Avenue, Toledo 12, Ohio—**Northeast Central**; Colonel R. W. Bunn, Forest Glen Section, Walter Reed Army Medical Center, Washington 12, D. C.—**Southeast Central**; Jay E. Graham, 1531 E. 4160 South, Salt Lake City, Utah—**Northwest Central**; C. A. Vieser, 2055 Pope Street, Beaumont, Texas—**Southwest Central**; John H. Huber, 3425 N H 40 Avenue, Portland, Oregon—**North Pacific**; E. Chester Robinson, Mgr., Alameda Mosquito Abatement District, 3024 E. Seventh Street, Oakland 1, California—**South Pacific**; Dr. Luis Vargas, Apartado Postal 19205, Mexico, DF—**Mexico, Central & South America**.

VIRGINIA MOSQUITO CONTROL ASSN.

5709 Sellger Drive, Norfolk 2, Virginia

N. S. Beaton, Boykins, President
Kenneth R. McGahee, Suffolk, First Vice-President
G. A. Treakle, Craddock, Second Vice-President
George C. Lyon, Ocean Park, Third Vice-President
Rowland E. Dorer, Norfolk, Secretary-Treasurer

NEWS AND NOTES

IN RESPONSE TO OUR QUESTION ABOUT NEBRASKA IN THE LAST ISSUE BILL RAPP sends us some further welcome information about the progress of mosquito control in that State. He says he believes that the main purpose of insect control programs is mosquito control but that in many areas equal emphasis is on fly and mosquito control and some of the cattle feeding and non-irrigated areas are interested only in fly control. Professor Rapp shows that he hasn't entirely put aside teaching, by enclosing a list of five municipal demonstrations and one-day schools put on this May in Nebraska by the State Department of Health, of which Bill is the entomologist. The subjects included selection of equipment and materials, methods of control, how to set up a community program and demonstrations of equipment in operation. LEWIS OGDEN of the USPHS Logan Field Station was a guest instructor. Legislative Bill 378, relating to mosquito abatement and covering formation, operation of and assessment of taxes for mosquito abatement (the bill hopefully says "extermination"), has been passed by the legislature but had not yet been signed by the Governor at the time Bill enclosed his copy.

A. RALPH BARR SENDS US A NOTE ABOUT DR. PAUL MÜNCHBERG, a German entomologist who, as some readers may know, is studying parasitic Hydrachnid mites and would like to receive some living material from American workers. The mites are taken alive, writes Professor Barr, from mosquitoes and other hosts, placed in a special tube made from a goose quill (which Dr. Münchberg supplies) and sent in a letter airmail to Germany. Anyone who is interested in participating in this study can get more explicit instructions from Dr. Münchberg at Gelsenkirchen-Buer, Breddestrasse 21 (Gymnasium), Germany. From 7 to 17 June, throughout August and from 23 to 28 October, Dr. Münchberg will be at Soest, Westfalen, Windmühlenweg 93, Germany.

MORE THAN ONE HUNDRED MEMBERS AND GUESTS ATTENDED THE MEETING OF THE VIRGINIA MOSQUITO CONTROL ASSOCIATION at Virginia Beach the 21st of February. Speakers included BILL MURRAY of the 5th Naval District, who discussed the past role and future prospects of the helicopter in mosquito control, LESLIE D. BEADLE, of the U.S.P.H.S., who discussed encephalitis, U.S.D.A.'s JOHN FLUNO, who told about the present status of insecticide resistance, DR. BILL BICKLEY, of the Univ. of Maryland, who discussed and showed slides of the gnats and midges known as "false mosquitoes," and a number of others.

CHARLIE WHITE SENDS US FROM NORTH CAROLINA'S SALT MARSH MOSQUITO STUDY COMMISSION the report to the Governor which was issued under date of January of this year. This report, which is exhaustive but far from exhausting (to the reader, at least), covers thorough discussions of fresh water mosquitoes, mosquito-borne diseases, adverse effects of mosquitoes on comfort, economy and general welfare, the history of salt-marsh control in North Carolina, the standard methods of control, comparisons with control by military establishments within North Carolina and with that in other states, a survey of the engineering and biological requirements, the effects of control on wildlife and the ability of the localities to participate in the cost of a program. Emphasis is placed on the fact that merely "killing adult mosquitoes is the least satisfactory method," that "larviciding, no matter how long it is practiced, will never cure the mosquito problem," and the text brings out the major collateral benefits to be gained by permanent mosquito control measures; it ends with a proposed bill "To Be Entitled an Act to Authorize the Creation of Mosquito Control Districts, etc.," together with a map showing the areas where such districts will be needed.

AND SPEAKING OF REPORTS, THE ANNUAL REPORT OF ED WASHBURN'S TURLOCK, CALIFORNIA, MOSQUITO ABATEMENT DISTRICT marks a milestone in the history of his District, since it records the end of ten years of highly successful operation. During this ten years, the District has grown by petitions of annexation from 342 square miles to 966 square miles or 618,240 acres. Despite the well-known factors of increased inflation, increasing demands on the part of the public for bigger and better service, and decreasing effectiveness of insecticides and despite the additional factors of increased irrigation and the advent and almost explosive spread of a species of high biotic potential, Turlock has managed to keep going at the same tax rate, except for a slight rise for 1954, ever since 1948. Like North Carolina, Turlock lays emphasis on source reduction and notes a high and increasingly greater degree of cooperation on the part of its citizens.

THE CALIFORNIA MOSQUITO CONTROL ASSOCIATION'S ENTOMOLOGY COMMITTEE SPONSORED, on the last two days of March, a seminar on mosquito and gnat problems which are related to mosquito control activities. Forty-five persons attended and brisk discussions were held on four general subjects: the influence of the weather on mosquitoes, California tree hole mosquitoes, gnat problems related to mosquito control problems and factors affecting mosquito oviposition. Moderators were R. C. Husbands, J. N. Belkin, L. M. Smith and Marvin C. Kramer, and R. W. Gerhardt, respectively. A dinner meeting, preceded by an open house with Dr. Stan Freeborn as host, concluded the sessions and plans were laid for subsequent annual meetings, with the general

consensus that discussions in the future should include also other arthropods of medical and past significance.

JOHN MULRENNAN SENT US A LETTER ABOUT SENATE BILL 704 (which we received just too late for the March issue), in which he pointed out that the Bill, introduced by Florida's Senator Holland, had received the support of the Florida State Board of Health, Chamber of Commerce and Public Health Association, and of the American Public Health Association, as well as that of a number of states, and added that the support of State and Territorial Health officers and of mosquito control associations was solicited. The Bill, as many know, was introduced in January of this year and provides that "while recognizing that the control of mosquitoes is, and should be, primarily the duty and responsibility of the State and local governments concerned, hereby establishes a policy and program of (1) aiding and supporting . . . technical study and research carried on by State health departments and by other qualified research organization . . . (2) providing grants to aid States in the conduct of demonstrations for the purpose of developing methods for the control of mosquitoes, and (3) providing Federal technical facilities and services to aid States. . . ." Such bills have been discussed in AMCA meetings for some years and most of us seem to agree that it will certainly be desirable to have the principle recognized that properly successful local mosquito control programs are also a matter of national importance.

DON MICKS SENDS US WORD OF THE FURTHER GIANT STEPS TEXAS HAS BEEN TAKING in the establishment of mosquito control in that State. Dr. (Professor) Micks' letter reads, in part, "The Galveston County Mosquito Control District, under the direction of William M. Cox, has been host to mosquito advisory commissions and many other interested citizens from Harris, Brazoria and other Gulf Coast counties who have come to the district in operation. The responses received concerning the success of the Galveston County program have been most enthusiastic. Other counties are now planning to activate programs organized along similar lines. On a year around basis, one species, *Aedes sollicitans,* constitutes over ninety percent of the total mosquito problem. Other *Aedes* as well as species of *Psorophora, Culex, Culiseta, Anopheles,* etc. are poor 'runners-up'." Don goes on to say that only a brief ophthalmologic study made it apparent that not even a Texas salt-marsh mosquito can recognize county lines (Tush, tush, Don, Texas mosquitoes *know,* they just don't give a damn). Texas is getting so enthusiastic that without pausing to consolidate their growing inter-county cooperation, they plan their next meeting for Orange County so that they can start linking hands with neighboring parishes in Louisiana. Don is President of the Texas Association this year and Dr. PAUL R. MEYERS is the President-elect.

"OUR GOOD FRIEND HANNES LAVEN OF THE MAX PLANCK INSTITUT FÜR BIOLOGIE in Tübingen, Germany writes that he recently received the Stifterverband Award for the most outstanding research in the field of genetics in Germany," Don's letter continues. "This high honor comes as no surprise to those of us who have been following his investigations."

THE PROBLEM OF TREE-HOLE MOSQUITOES IN CALIFORNIA is, as has been noted previously in this section, of growing importance, particularly as control in other sectors becomes more and more effective. CHET ROBINSON and MARV KRAMER have met this situation not only by increasing their control efforts in the field but by the issuance of an excellent little eight-page primer to educate the public as to what the tree-hole breeders are and what to do about them. The Alameda County Mosquito Abatement District also reports that in addition to the satisfactory progress being made in their studies of non-biting gnats and midges of nuisance importance, their work with weed-killers in the soil sterilant class has been so productive that they plan to do "considerable weediciding of [their] drains this fall, in order to eliminate the necessity of larviciding some of them."

LES BRUMBAUGH REPORTS FROM HIS YOUNG BUT VIGOROUS SAN JOAQUIN (CALIFORNIA) Mosquito Abatement District, that, following in the path so earnestly urged by Virginia's ROLLIE DORER, they are using a goodly number of light traps to keep them informed on need and effectiveness of their control measures. They continue to have good success in working the property owners over to their side in the source reduction program, among these the owner and renter of some 300 acres of swampy land which has been one of the largest mosquito sources in the area.

OTTO MCFEELY AND FRANKLIN WRAY POINT OUT IN THEIR DESPLAINES VALLEY MOSQUITO ABATEMENT DISTRICT REPORT that the cost of control in their area in 1956 came to only "42¢ per capita, less than two packages of cigarettes." Cigarettes don't cost quite that much in California, thank goodness, but the point is well taken, just the same. They report that due to the widespread building boom in the Chicago area, some of their source reduction work has been reversed but that nonetheless they are still reducing the total mosquito-breeding areas.

SINCE COMPARISON WITH THE FINDINGS OF OTHERS IS ONE OF THE STIMULATING BENEFITS OF OUR A.M.C.A. it is of interest to read in the Desplaines Report that they make a practice of spraying or fogging, when it will not interfere

with routine operations, as a service for outdoor parties and picnics held by non-profit organizations such as churches, schools, Boy Scouts and Girl Scouts and various community organizations and celebrations. Light trap catches have been utilized to give some very informative statistics on mosquito species populations and also to serve as guides for the peak activity hours when fogging will be most effective during the atmospherically appropriate times of day. A study of resistance indicated that in a few spots there was some slight possibility of a low degree of it but that on the whole, DDT resistance is practically non-existent in the District.

The Morris County Mosquito Extermination Commission Announces Its New Address is now on Highview Avenue, Morristown, N. J., which runs off Hanover Avenue to the east, and one block south of Evergreen Ave. Their Post Office address is P.O. Box E, Morris Plains, N. J., and their telephone is the same as before: JEfferson 8–1538.

Uncle Harry Stage, Who is About as Well Known to the Citizens of His New Home Town Portland as He is to Members of the A.M.C.A., was written up in the Sunday *Oregonian* Magazine on April 14, 1957, with pictures and everything. (The pictures show Harry sitting with his usual easy poise in front of a house in Vietnam, flanked by two Vietnam belles who are pretty much au natural, but unfortunately well chaperoned by Mother, Father, Elder Brother and someone identified as Harry's Aide. Harry is seated, we note, *between* this handsome young aide and the above mentioned pretty girls!) Well, to get back on the track, the article is a short but well-deserved tribute to Harry and it has some little-known info we think you might like to have.

First of all, we take it you know that Harry was born in Crittenden, N. Y. at an early age and got his B.S. and M.S. from Syracuse University. He is married and the father of two children (his son is a physician) who have some time since put Harry into that select category known as Grandfather. Harry was a principal sparkplug in the U. S. Department of Agriculture for many years, at which time we'll let the *Oregonian* take it from there. "Stage came to Portland in March, 1931, as entomologist in charge of mosquito investigations in the Pacific Northwest for the United States bureau of entomology and plant quarantine, department of agriculture (sic. The *Oregonian* doesn't upper-case bureaucracy, so it seems.) Stage had had ten years' field experience in mosquito control for the St. Louis Southwestern railway. Working up the Willamette valley from Portland on a survey, Stage and his associate, C. M. Gjullin, found malaria and mosquitoes both plentiful." After discussing how they broke this up, the *Oregonian* continues, "In World War II he was sent in 1943 to Hudson's Bay to test mosquito repellents. . . . In 1944 he made a mosquito survey of Alaska for the Surgeon General's Office. . . . The next year he was one of 18 specialists sent to Panama with two-engined planes to test the efficacy of spreading DDT over heavy jungle. Results were spectacular. . . . In 1945, Stage was sent to Mexico to review a program for controlling an *Anopheles* not found in the United States, by spraying the inside of houses with DDT in emulsion. The procedure was effective. . . . Late in 1945 Stage went into Dutch Guiana under auspices of the Aluminum Company of America, whose bauxite mining there was beset with malaria. . . . Stage tried [spraying the inside of houses] in Moengo, an isolated jungle town of 2000 inhabitants. . . . Back a year later to check, Stage found the thatched huts still insect proof. . . . A mosquito specialist really gets around. (This is the *Oregonian.*) In 1948 Stage made mosquito studies on islands north of the North American continent for the Canadian national defense board. In 1949 he went to Africa as guest of the British colonial office to review medical and veterinary entomogical research in British East and Central Africa and the island of Mauritius. In 1953 he was a delegate to an international congress on malaria control that met in Turkey. . . Stage in 1953 looked for a climax to his career . . . and as a result was sent on a 2½-year assignment to Indochina, now North and South Vietnam, Laos and Cambodia. While in Vietnam Stage discovered two previously unobserved species of mosquito, and one of them was named for him, *Culex stagei.* That one lays its eggs only in the cup of a jungle pitcher plant. . . . Talking with him, however, one gets the impression that his thoughts are on far horizons. The work to which he has devoted his life is only half done."

Seeing Sam Edgar's Name on a Recent Article in *Mosquito News* Sent Our Mind Back to Happy Days Ten Years Ago in the Philippines. Dr. S. A. Edgar of the University of Alabama, he is now, and his name has been more associated with chicks than with mosquitoes, of late, but then he was the ball of fire in malaria control for the Armed Forces Western Pacific, the residual command MacArthur trailed behind him as he moved into Tokyo. Malaria control had all but broken down then, and many people were laboring valiently to restore it and to improve it, a work only now coming to fruition, but none was more energetic or more enthusiastic than young Captain Edgar. (For a while he was even mere Lieutenant Edgar, in a flock of Colonels, but that never fazed him.) Well, we all panted along behind, open mouthed, sort of. Maybe we ought to start off Who's Who with him. S. Allen Edgar was born in Stafford, Kansas, and received his B.S. from Sterling College in 1937, his M.S. from Kansas State in 1939 and his Ph.D. from Wisconsin in 1944. Re-

turning from the Philippines, he went to Alabama for 3 years, then for 2 years to Tahiti with the U.S.P.H.S. He's back at Auburn again now, working, as we said, principally on protozoon diseases of poultry but retaining a lively interest in mosquitoes, too. He's married and has two children and (since he didn't put *any* of this down on the back of his Who's Who form) we haven't any idea what his hobbies are, but remembering the Philippines, they used to be exotic birds, orchids, and making friends.

ARTHUR V. REGNIER, JR., another of our one-time leading lights in military malaria and encephalitis control, was born in Dublin, Mississippi in 1915, but was reared in Arkansas and Texas. He received his B.A. and M.S. degrees from Iowa State and from 1950, when hostilities broke out, to 1954, Art was a lead man with his control detachment mopping up on mosquitoes in the areas mighty far forward. Captain Regnier changed to Mr. Regnier after a hitch at the Army Medical Field Service School at Ft. Sam Houston, and went to Japan again for two years as a civilian entomologist, where he had first met his lovely wife. In 1956, he joined the U. S. Public Health Service and was detailed to the I.C.A. advisory group in East Pakistan, where he will be working on malaria control for two years. His new address is, he has asked us to note, APO 74, Box DAC, % Postmaster, San Francisco, California. Let's have a note or two from your area, Art! How's the photography there?

OTTO MCFEELY claimed a couple of years ago that he was in his seventy-eighth year and retired, but all of us who have seen him in action as a mosquito control patron think he must be wrong on both counts. Like a well-known comedian on the radio and TV, Otto apparently just stuck at 39 and he is certainly far from inactive. After a full career as a journalist, however, including service in the Spanish-American and First World Wars, from which he departed with the rank of Major, he became actively engaged in promoting mosquito control and has been at it ever since. This started when his young daughter was badly bitten by mosquitoes in 1920, he says, and by 1927 the state legislature had been brought to see the light and enacted a law authorizing mosquito control districts.

CDR. JOHN M. HIRST of the U. S. Navy, MSC, and our President-Elect, hasn't been biographied in the Notes before, partly because he is so very well known to all, but principally because we were saving him to add lustre to a list of military mosquito control men which we've been meaning to run. Well, now that the Miami meetings are over, perhaps we'd better tell you about him after all. "Mo," as he is called, sometimes shortened to "Mighty Mo," was born in Indiana, Pennsylvania (that's what it says) in 1908 and his first speech was delivered impromptu and with his usual dexterity en route to the arms of the nurse. (Knowing Mo, we judge too that she was a *pretty* nurse.) Besides acquiring degrees such as a B.S. from Bethany, and M.S. from Pitt and a Ph.D. from the same University, Mo has had a mighty varied background of professional activities outside entomology. At one time he was a professional musician, playing dance music and burlesque with equal aplomb and acquiring a breadth of adaptability which has not only increased his considerable gifts as a raconteur but ameliorated the austerity which might otherwise go with his also very considerable erudition. After ten years as a teacher, he entered the U. S. Navy in 1942, and has had a good deal to do with setting up control techniques in that Service, including the development of automatic disinsectization equipment for aircraft. He is also a member of numerous scientific societies including Sigma Xi and Phi Sigma. He is married to a charming lady who, like Mo, is active in community work, and they have two teen-age youngsters. Mo lists his hobbies as golf, micro-photography and model railroading, none of which he ever has time to practice, and neglects to add that he is a choir director, moving spirit in the Teen-age Club for service youngsters of the Bay Area, Boy Scouts and many other Good Works.

DR. FRED C. BISHOPP, whose address is still 8014 Piney Branch Road, Silver Spring Maryland, but who has been in California and Florida on another of his circle tours of the world, the hemisphere or at least America, writes that he was mighty sorry to miss the Miami meeting, a sorrow we all share. He sends us the following note:

"On May 9, 1957, in Elizabeth, N. J., the new headquarters of the National Pest Control Association was dedicated to the memory of the late William Oscar Buettner, outstanding Executive of that association for many years.

"The impressive dedicatory program was conducted by J. Edwin Sameth, Past President of the N.P.C.A. and member of the Essex County, N. J., Mosquito Extermination Commission.

"The dedicatory address was made by George R. Elliott, President of the N.P.C.A., 1943–44. The bronze tablet was unveiled by Mrs. Buettner, with her two sons at her side.

"Participating in the program also were: John K. Medoff, New Jersey Senate, Lewis W. Jones, President, Rutgers University, I. B. Carncross, President of the N.P.C.A. for 1955–56, Myron W. Smith, current president of the N.P.C.A. and the Reverend Charles L. Copenhaver.

"Some 20 states and 2 Canadian provinces were represented at the ceremony. Ten past presidents of the N.P.C.A. were in attendance and an even greater number of entomologists. Among the latter was a considerable number of official entomologists and fish and wildlife experts, several of

whom are actively concerned with mosquito work.

"The building was one of the fine old residences of Elizabeth, located at 250 West New Jersey Street. It is well adapted to the needs of the National Association, providing offices which include those of the Executive Secretary, the well-known entomologist Ralph E. Heal, and his staff.

"Mosquito control and research workers are finding pest control operators more and more interested in mosquito and fly control and ready to assist in furthering work against those pests. Members of the American Mosquito Control Association will be glad to learn of this forward step in the life of the N.P.C.A. and the recognition of the monumental contribution made by Bill Beuttner to the work of the Association. Dr. Heal and Dr. Speer will be pleased to have members of the A.M.C.A. visit them in their new home."

—Fred C. Bishopp

THE NORTHEASTERN MOSQUITO CONTROL ASSOCIATION held its 3rd Annual Meeting in Providence, R. I. on February 14 and 15, 1957.

Highlights of the meeting were (1) discussions of Eastern Equine Encephalomyelitis; insecticide residues on plants and how mosquito control operators may avoid damaging crops and leaving objectionable residues, (2) a report of studies on the biology and control of Greenhead Flies, Gnats and Midges on Long Island, N. Y., and (3) a complete resume of the mosquito research being carried on by the Entomological Research Branch, U. S. Department of Agriculture.

During the business session the following officers were elected: Lewis F. Wells, Jr. South Shore Mosquito Control Project, President; Hugo Jamnback, N. Y. State Science Service, Vice President; Kerwin Hyland, University of Rhode Island, Executive Board Member for 3 years. Robert L. Armstrong, East Middlesex Mosquito Control Project, continues his term as Secretary-Treasurer.

REVIEWS AND ABSTRACTS

PHYSIOLOGY OF THE COMPOUND EYE. By V. J. Wulff. Physiol. Revs. 36(2):145–163. 1956. This review summarizes current physiological information on the nature and probable mechanisms of sensitivity to polarized light, color and pattern vision, and migration of pigment in arthropods.

The positive electrical response when a compound eye is illuminated is called the retinal action potential. This depolarization is generated by sense cells. Under low illumination the potential soon reaches and maintains a plateau upon which is superimposed discontinuous spike deflections. In *Limulus* the eccentric sense cells and axons of the lateral eye become electrically active but the retinula cells and their axons stay inactive.

Insects have either "slow" or "fast" type compound eyes. In "fast" type eyes the retinal electrical response is diphasic (a positive "on" and negative "off" component). The absolute sensitivity of fast types to light is low compared to slow types. Some insects with fast compound eyes are *Calliphora, Cynomya, Apis, Vespa, Bombus,* and other fast-flying diurnal insects. Since the fast eye has a stable electrical response during light-dark adaptation it has been suggested that photochemical events may not control the electrical changes. It is believed that centrifugal neurons in optic ganglion I are responsible for the properties of fast eyes.

In slow compound eyes the electrical reaction is a monophasic wave in the cornea. High absolute sensitivity to light, and poorness at resolving flickering light characterize these eyes. The slow eyes increase their electrical response during dark adaptation and decrease it during light adaptation. Slow eyes do not have centrifugal neurons. Insects having slow compound eyes include the grasshopper, *Dytiscus, Vanessa,* and slow moving insects.

The author recalls the special sensitivity of many arthropods to polarized light (including some unidentified mosquito larvae). He reviews some of the fascinating studies that have been made to determine how the compound eye can detect the direction of oscillation of polarized light. In *Limulus* the lateral eye's electrical pattern varies with the direction. Rotation of the polarizer alters the frequency of electrical activity. It is suggested that the effect is brought about by reflection-refraction phenomena at the surface of the cornea. Excised bee eyes give larger responses to polarized than unpolarized light of the same intensity which indicates that polarized light is a better stimulus. It is still not clear whether the mechanisms (s) of polarized light analysis in the compound eyes of insects is intraommatidial in nature, or due to an analyzer at the corneal surface, or to some other type.

Compound eyes of many arthropods are capable of detecting color, and color perception is frequently, though not always, associated with behavior patterns. Bees and *Calliphora* have trichromatic vision, i.e., they detect violet-blue, blue-green, yellow-red regions of the spectrum. Bees and noctuid moths detect ultraviolet. Arthropodan eyes are notably more sensitive to the violet than vertebrate eyes, and considerably less sensitive to the red end of the spectrum.

Arthropodan eyes are 100–1,000 times inferior to the human eye with respect to resolution of detail. Fast flying diurnal insects translate light and dark patterns into temporal displays of sequential stimuli and are then able to distinguish contrast, contour richness, degree of subdivision. Little is known about these aspects of vision in slow moving or nocturnal insects.

Although much is known about pigment migration in Crustacea, very few investigations have been made on this interesting subject in insects. Apparently in Crustacea the migration is under elaborate nervous and hormonal control but in insects (*Ephestia*) it seems to be only under nervous control.—Jack Colvard Jones, National Institutes of Health, Bethesda, Maryland.

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